SEPTEMBER 1995 ISSUE #49

Radio Fun

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"The beginners guide to the exciting wor

Mickey and SIS-70

It was Mickey Mouse and the space shuttle on Monday, July 17th. This, when educator Gordon West WB6NOA made contact with the crew on-board the space shuttle *Discovery* using ham radio at the same time he was talking to a commemorative station operating from the Disneyland theme park in Anaheim, California. We asked Gordon to tell the rest of the story:

"Space Shuttle Discovery, this is WB6NOA. Congratulations, you are going to be Disneyland's 40th contact on their 40th birthday."—Gordon West WB6NOA

"WB6NOA, I have been there two or three times. My sister used to live out in San Diego. We would go up to Anaheim and go to Disneyland. That is one of my favorite places in the world. Tell Goofy and the rest of the folks that we said Hello."—Shuttle Astronaut

"Roger, space shuttle *Discovery*, this is WB6NOA for Disneyland on their 40th."—WB6NOA

WB6NOA has talked to numerous hams around the world. He says that this extraterrestrial QSO was very special for him and also for the world's most famous mouse.

West's Disneyland to shuttle relay QSO was made in conjunction with a special event station on the air from Disneyland on July 17th. The commemorative operation used the call sign of Archie Willis W6LPJ and operated on all High Frequency bands as well as VHF and UHF packet. The event was sponsored by Disney Emergency Amateur Radio Club. TNX *Newsline*

Nine-year-old Tricia Smar gives her dad, Gene Smar AD3F, a hand with the 900-MHz loop yagi set up. See Gene's letter on page 4.

PAL HAM

Attention hams in the Los Angeles, California, south bay area. The Long Beach Police Department Athletic League Amateur Radio Program known as Pal Ham invites all interested kids in the region aged 7 to 18 to join the program. While its next Novice-Tech class doesn't begin until September 30, the group is open every Saturday, from 8:30 AM to 3:30 PM with a fully operational station, complete with 2 meter packet, VHF, UHF, HF, AMTOR, and PACTOR.

This is a wonderful opportunity for kids to get on the air, especially those who are unable to set up a station in their home.

The Pal Ham Advisor is Detective Paul Bowman N6WZR, and you may leave a message for him at (310) 495-2732. You can also leave a message for him on packet on N6WZR@N6YN. TNX *Newsline*

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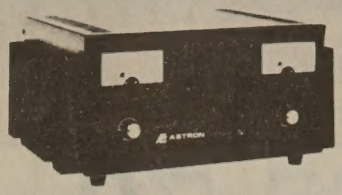

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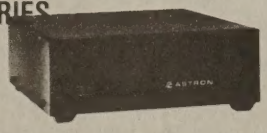


- LOW PROFILE POWER SUPPLY

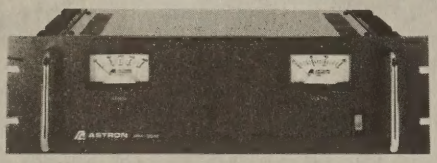
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES

- POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

RM SERIES



MODEL RM-35M

- 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

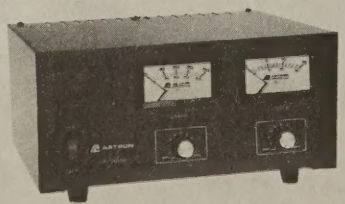
MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

VS-M AND VRM-M SERIES



MODEL VS-35M

- Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
VS-70M	57	34	16	70	6x13¼ x 12⅛	48
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

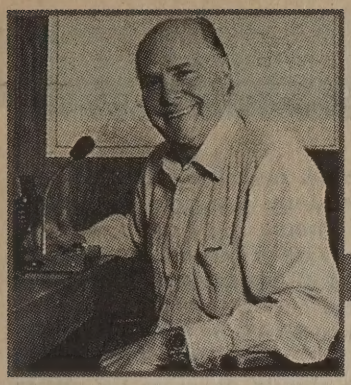
MODEL RS-12S

- Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD



Welcome Newcomers

by Wayne Green WNSD/1

Depending on how much adventure our school system has left uncrushed in your heart, amateur radio has lots of exciting options open for you. But, to know what's going on and how to get in on the fun, you have to get one or more of the ham magazines.

Some hams get their tickets and spend their ham lives tied to an HT and a couple of local repeaters. Others stick to one or two 75 m nets. Others are sending miniature TV cameras up in balloons, going to ridiculously out-of-the-way spots around the world just to fight pileups of feeding-frenzy DXers into semi-submission. Then there's the excitement of snagging a new one via one of the ham satellites. Or being shown the depths of a salt mine in Krakow, Poland, as a visiting ham.

There are four ham rags and a welter of specialized ham newsletters. I know you're going to find this difficult to believe, but over 60% of the hams are so set in their ways and resistant to something new that they don't read any ham publications at all! I get 'em all and thumb through to see what's exciting. Most don't take very long, but there's always the chance that I might miss something. But that's the way I am about my hobbies; so I check out the sports car, skin diving, travel, science, flying, health, education, and skiing magazines, too.

In the ham field there's mainly *QST*, *CQ*, *73*, and *Radio Fun*. Being a doer more than a watcher, for me the ARRL club news is a bore. If I were really into DXing, I suppose *CQ* would have more of interest to me. But I prefer to talk with DX rather than "work" it, so I'm not excited about contests. They tend to be dominated by a few fanatics with super stations.

So I've been steering *73* toward covering the newer aspects of the hobby, plus plenty of building projects. Because the most fun for me has been getting involved with a new aspect of the hobby, I tend to push that in my magazines. I helped pioneer a bunch of new modes down through the years and I had a ball doing it.

My message with *Radio Fun* is that we have a fabulous hobby, but only if you dare to open the doors of your mind to new experiences. I try to keep the stuff in this magazine simple enough for newcomers. I've rounded up a great bunch of columnists who know their stuff and want to get you involved.

I want to be able to get on slow-scan TV and get pictures from you, while you're telling me that it was one of my magazines that got you going. I preach entrepreneurialism in my editorials; thus, I love it when a ham comes up to me at a hamfest and thanks me for getting him off dead center and into starting his own business. That's about the only way one can make big money these days, and create the main avenue to personal freedom.

By getting involved in new aspects of the hobby, you are going to learn—and keep on learning. The early repeater developers saw the potential for cellular telephones and many did very well. Ditto the hams who got involved with computers early on.

So, am I going to start getting messages from you via packet? Will I be working you over one of our satellites? Or from some wet rock in the South Pacific? Or will I hear you over a local repeater somewhere complaining about something?

Yes, I know all about the code barrier to the Advanced ticket, the one you need to have if you are going to work any serious DX. Well, I've got a code-learning system that makes the process pretty easy. You can pass the 5-wpm test with about a half hour of study, The 13- or 20-per may take a couple of weeks of maybe half-hour-a-day periods. Check out my 13- or 20-wpm tapes. But learn the code at the speed you want to know, and whatever you do, don't try to start slow and build up your speed. If you're going for Extra, don't horse around with 13 per. Start with 20.

Your no-code ticket is your ticket to ride; now get your transfer to Advanced and take the express. RF

REPEATER MAP BOOK

The new ARRL North American Repeater Atlas is out. The publication is not to be confused with the pocket sized repeater directory. The Atlas features repeater maps for every US state, Canadian province plus Mexico, Central America, and the Caribbean. Contact League headquarters for pricing and availability.

Also, the ARRL will produce a handout aimed at new hams, explaining the concept of band planning. The publication will include a listing of ARRL approved plans. TNX *Newsline*

FCC ORDERED BY COURT TO DELAY AUCTION

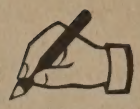
The Federal Communications Commission has been forced to again suspend its auction of spectrum. This, after a federal court ordered it to delay plans to proceed with the sale in late August.

According to FCC chairman Reed Hundt, this latest court imposed delay will hurt competition, cost consumers and threaten opportunities for small businesses. Hundt says that the commission has done everything possible to press forward with the auctions. This includes changing the rules to remove bidding preferences for women and minorities.

Chairman Hundt adds that the FCC plans to pursue every possible legal avenue to get the auctions back on track as soon as possible. TNX *Newsline*

Radio Fun

Letters



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Pete Theiler KI4KN, Spartanburg SC I always enjoy reading your editorials and, based on your recommendations, I have been reading about the influences of electric and magnetic fields on life processes.

Years ago a friend of mine in Europe used a device that passed a minute electric current (in the order of 50 to 200 µA) through the body. This was simply a battery, meter, pot, and electrodes. In fact, I think it was a commercially available device. This friend suffered from fainting spells and other disorders. He swore that this device helped him by stimulating his blood circulation and that it could also speed up healing. I had not taken any of this too seriously until I began reading *Cross Currents*, by Robert O. Becker, M.D., and decided that there may be something to it. From what I have read, the current is probably still way too much at 50 µA.

> "Thanks for providing an alternative to the staid and stodgy publications on the market today. Keep up the good work for many years to come."

Thanks for your help and keep giving us hell in your editorials; most of us are just too complacent.

Larry Pitt KBØMOT, Harvey IA *Radio Fun* is an interesting magazine for new hams. I like your editorials, but I totally disagree with your comments on the code requirements for general licensing. I'm a Tech Plus now starting as a no-code. I will be a General in a few weeks. I enjoy the challenge of the code. Don't make the ticket an easy thing to get. I like CW and have purchased a Bencher Paddle and top-of-the-line MFJ Keyer as an important part of my shack. I'd bet this letter won't be in the magazine! Sincerely, A newcomer having a *great* time with CW!

Mike Carbaugh WA3HDQ, Adams NY First, a little background info. I've had my ticket since 10th grade in 1967. I worked a lot of 6 m AM and 2 m FM, back when 2 meter was fun. It seems as if nowadays each repeater has its own little "group." But I still use an HT in the car. I commute 52 miles one way and it's nice to have.

I faded away from ham radio back in the late 70s. Since Techs were given 10 m, I got back on the air in 1992. I run a barefoot, no-frills station. . . .

Some random thoughts for newer hams and others:

1. Two m/10 m crosslink repeaters are a lot of fun; try them out if any are in your area.

2. Send a SASE or postage when QSLing.

3. Clubs should do more for newer or lower-grade licensed hams. Let them do some operating at field days, and during contests and special events. Loosen up the meetings so that everyone is not held strictly to business.

4. Don't be so quick to point out that a newcomer to the repeater made a mistake and said, "Break."

5. Look what Techs and Novices did to activity on 10 m! An allotment of more privileges on HF band could increase our amateur ranks.

6. My last 125 ten m contacts were composed of the following:

63—Tech or Novice class,
20—General class,
24—Advanced class,
18—Extra class.

7. It seems to me that everyone is taking advantage of Tech and Novice activity on 10 m.

8. What could we bring to other HF bands?

One final thought: I agree with you and so do many other hams regarding eliminating the code. It's holding back many good potential hams.

Gene Smar AD3F, Rockville MD Enclosed is a photo (see page 1) of my youngest of three daughters, Tricia. I took this photo last year while I was putting up a 900 MHz loop yagi for local ATV work here in the DC area.

Please feel free to use this photo in *73 Amateur Radio Today*, or *Radio Fun*, either as a cover photo or elsewhere inside the publication.

I've enjoyed reading your mag for years, beginning as a Novice in the mid-60s. As a matter of fact, the first article I ever wrote was published in the September, 1967 issue of *73*. I opened my first bank account with the money I earned from that article.

Thanks for providing an alternative to the staid and stodgy publications on the market today. Keep up the good work for many years to come. RF

Review by Peter A. Bergman NØBLX

Ten-Tec
1185 Dolly Parton Parkway
E. Sevierville TN 37862
Telephone: (615) 453-7172
Price Class: $27.00

Ten-Tec 1056 Receiver Kit

T-Kit? Read that Ten-Tec. Kit? You bet! When I first heard that Ten-Tec had gotten into the kit business, I sent for their catalog. I was pleased with the contents: VHF amps, 6 meter transverter, several different receivers, a 2 meter transceiver, and all kinds of other neat stuff. The prices seemed decent, too. So, since I enjoy building but am not much of a designer, I had to try a T-Kit.

The 1056 Receiver Kit

After agonizing like a kid in a candy store, I finally chose the 1056 board kit. The 1056 is a direct conversion receiver, meaning it makes the transition from antenna to headset in one jump. DC receivers have several advantages over superhets, such as simplicity, low cost, and low power consumption. It is even possible to build one with no active components except the local oscillator. There is a downside: They are subject to overloading so that a strong local signal might be heard across the band. Common-mode hum can also be a problem, which is why using a battery power supply may be preferred.

The 1056 DC receiver uses an NE612 mixer/oscillator, and an LM358N op amp, half of which provides some of the audio amplification, while the other half is used as a front panel bandpass control. The signal then passes through a TDA2611A amplifier to either the headphone jack or a speaker. Tuning is accomplished with an MV209 varactor diode.

The kit I received included the 2-1/4" by 6" printed circuit board and all onboard components, including all of the capacitors and inductors needed to allow me to build the receiver for the ham band of my choice.

This unit is designed as a single-band receiver but T-Kit supplies all the parts to allow you to choose, change your mind, or even figure out a band-changing scheme of your own.

The board is single-sided and unplated. The silk-screening on the component side is nice and clear, though I do wish the identification for the variable inductors wasn't located so it would be covered by the components. This is not much of a problem since the assembly manual includes an oversized X-ray view of the board with the part locations clearly marked, but I'm cranky that way.

The parts supplied are of good quality and everything promised was there, with one exception. Search as I might, and I looked everywhere, I could not find one of the 3.3-ohm resistors. Rather than goof around sending to Tennessee, I checked my junk box but found only three 10-ohm units. So, that's what I used. I'll come up with the correct part one of these days and remove the monster I have in there now.

Assembly

As this is a very small, simple kit you will not need a large tool kit to build it. A 15- to 30-watt soldering pencil, diagonal cutters, needle-nosed pliers, an alignment blade, and an RF-signal source will do. Use rosin-core solder only! A magnifier and curved forceps are also handy. I formerly used the magnifier to read small print on parts or plans. Now the parts are getting so small I sometimes need it to find some of them.

If you are totally new to building, take a look at Radio Shack's Archer 64-2801A 10-piece toolkit. That or something like it should be a good place to start putting together a set of tools.

In addition, you will need a well-regulated, well-filtered 8- to 15-volt DC power supply, an antenna, and headphones or speaker. You will also want some kind of a case. I have mine in a video cassette box until I decide where it is going from there.

I avoided most of the hum/hash problems sometimes associated with AC power supplies by using a 10-amp gel-cell battery. The 10 amps is a bit of overkill for the 1056, but what the heck.

The manual says a 10- to 20-foot random wire antenna is adequate. I had to get fancy and put together a 30 meter folded dipole. It works better than a couple of clip leads, but not much.

If you have a pair of "walkthing" headphones, they will work fine. I'm using the little speaker from a dead 11 meter rig. I have a couple of bigger ones in the junk box that sound better but I'll probably continue using the little one in the interests of portability.

Builders have different standards by which they judge a kit. Assuming all else is equal, the assembly manual can make or break a kit for me. I want to be told what the device is supposed to do and how it does it, where the parts are supposed to go, and what the parts look like. I really like power-on, functional tests and, as a bit of gravy, I like suggestions about how to make modifications or add features.

I do not like mixed-up steps, ambiguous instructions, or missing pages or—cranky me—even missing parts of pages. I absolutely hate mystery components—amorphous little lumps with two or three leads and no hint as to what they are or do. One or two of these in a kit might be considered challenging but more than that can ruin your day.

The manual for the 1056 meets all my expectations. The print is clear, the instructions are very straightforward, and the ambiguity count approaches nil.

Assembly of any device should follow T-Kit's Five Commandments:

I. Choose the correct part.

II. Insert part in correct location.

III. Insert correctly—observe polarity on diodes, transistors, electrolytic caps, ICs, etc.

Continued on page 15

Communications Simplified, Part 1

by Peter A. Stark K2OAW

If you're into ham radio, then you are already into electronic communications as well. But if you are a beginner, or if you've limited yourself to contesting or chatting on your local repeater, you've probably missed out on a lot of the more interesting technical parts of communications. This series of articles will try to bridge that gap, but in a simple (and hopefully interesting) way.

These articles are the result of a community college course I have been teaching for some years. Since I haven't been able to find just the right textbook for my course, I've decided to write my own course notes. Eventually, these notes will become a textbook, but for now you're looking at just the notes.

But don't be scared by the idea that this comes from a college course—it isn't as complex as you think. First of all, I teach a survey course. That means that it's an introduction to communications for students who haven't taken any other communications courses before. So it starts fairly simply, and doesn't assume a lot of previous knowledge. In those areas where it assumes some knowledge from a prior course, or where it seemed like a good idea to discuss some related topic, I've inserted what I call "detours"—short discussions that temporarily break away from the main subject.

Second, I teach a survey course that tries to cover a big area in just one semester. That means that there isn't time to go into tremendous depth on any one topic. Hence we have to stay fairly simple at all times. The course has a lot of descriptions and pictures, and almost no math.

Third, this is a community college course in the second year of a technical program. It's intended for students who will become technicians, not engineers or mathematicians.

Photo A.

Finally, Wayne has made me promise not to show off with fancy formulas and theorems, and to add a little sugar to make the material go down easier. (I guess that means I have to crack a bad joke now and then, such as "What do you get from a Mafioso college professor? An offer you can't understand!")

But before I start off, let me add a little fine print for the benefit of the many readers who probably know a lot more about this subject than I do. Please keep in mind that these articles are intended for beginners. As such, I will often provide explanations that may seem a little (maybe *very*) simple-minded to you. While my explanations will not be *wrong*, they may be very *incomplete*. Please don't barrage me with long treatises and reprints from other texts and journals if I've omitted or simplified too much (but do let me know if I say something that isn't true).

So let's get started.

Communications

Communications is simply the moving of information from one place to another.

An English teacher thinks of communications as the process of writing or speaking words, which tell your reader (or listener) something you want him or her to know. There is even something called mass communications, which is sort of like journalism, but for TV, radio, and film. In this course, on the other hand, we think of communications more as the electronic process and equipment needed to send information over long distances.

For our purposes, we are interested in three aspects of communications:

- What is being sent? In other words, what kind of information are we sending; is it sound, pictures, or perhaps computer data?
- Through what is it being sent? That is, what is the *medium* through which it goes—wire, radio waves,

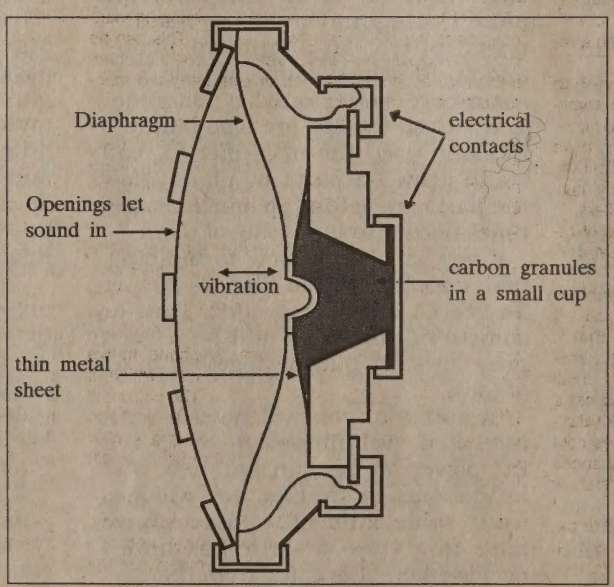

Figure 1. Telephone-type carbon microphone.

sound, light, fiber optics?

• How is it being sent? All by itself as in a telephone wire, or combined with other signals? Analog or digital?

It would be nice to be able to look at each one of these questions separately. Unfortunately, they all interact, and so our discussion will have to flit back and forth occasionally. Still, let's try to start with an orderly approach.

Let's start off with what is being sent. The information you send can be sound, video (pictures), or digital information. Let's look at each in turn:

Sound

Sound is simply the vibration of air. When we speak, our vocal cords vibrate the air coming out; the sound travels through the air until it vibrates the ear drum in someone's ear, which eventually winds up in sending nerve signals to that person's brain.

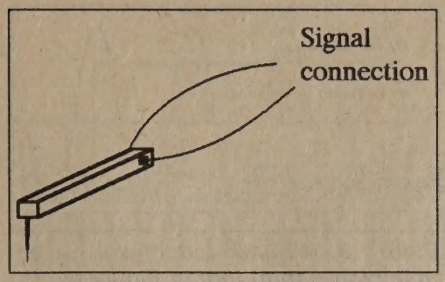

Figure 2. Simplified crystal phono cartridge.

In electronics, a microphone is used to convert the air vibrations into an electrical signal. The air vibrations move a thin metal or plastic plate (called a *diaphragm*) inside the microphone; a motion-to-electricity converter then converts the motion into an electrical signal. This signal is amplified and somehow sent from

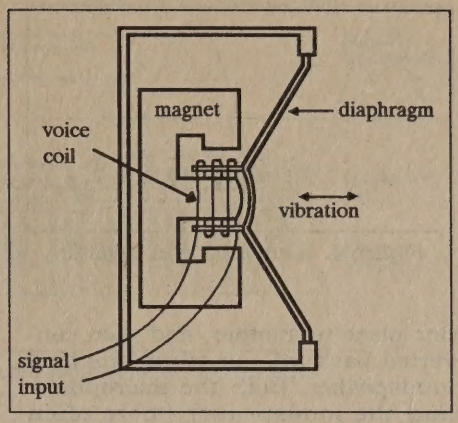

Figure 3. A telephone-type earphone.

DETOUR 1

OK, now you see how detours work. Let's detour to talk about transducers. Microphones (also called mikes) come in many different types. Most common is probably the carbon mike, because it is used in every older telephone (the old-fashioned kind, not the newfangled little phones made in the Far East. But not just the real old ones, as in photo A; more modern ones, too).

Like every microphone, the carbon mike has a diaphragm, which vibrates when hit by a sound wave. The diaphragm in turn moves a thin metal sheet that presses on carbon granules in a small cup. The electrical connection is made to the metal sheet and to the bottom of the cup, as shown in Figure 1.

The carbon granules are small particles of carbon, which act as a resistance between the cup and the diaphragm. The value of this resistance depends on how closely the granules touch. As the diaphragm vibrates, it alternately squeezes the granules to increase the pressure between them, or releases the pressure. This changes the resistance of the mike in step with the vibrations of the air. The mike is in series with a battery (back in the telephone company's central office, not inside the phone), and thus varies the current in time with the sound. The current variations are converted to voltage variations when the current passes through a resistor or a transformer.

It turns out that a carbon mike has very bad sound quality, but it has one advantage --- the voltage variations in the series circuit can be quite large, which means that the electrical signal from the mike can travel long distances without any amplification. This was obviously necessary back in the early days of the telephone, before there were any amplifiers.

Carbon mikes were used in the early days of radio, too, but they were soon replaced by better-sounding mikes.

One inexpensive mike still commonly available is a crystal or ceramic mike. This kind of mike uses a crystal (usually quartz) or ceramic material that is *piezo-electric.* This kind of material is a natural transducer: If you connect a set of terminals to a small block of the crystal or ceramic material, you get a voltage when you squeeze or twist the block; alternatively, the block twists or changes shape if you put an external voltage across it. So it naturally changes mechanical movement into an electrical signal, or vice versa.

Piezo-electric materials have many uses. For example, Figure 2 shows the idea behind a crystal phonograph cartridge. The needle is attached to a small block of crystal. As the needle rides in the record groove, it twists the crystal, and the two wires attached to the other end generate a voltage proportional to the needle movement. When sufficiently ruggedized, it also works backward. For example, some 40 years ago, Astatic created a recording head that used a crystal to make records. When fed with 50 or 100 volts of audio, the crystal would move a sharp needle and cut a record.

Although crystal cartridges are no longer popular, piezo-electric materials are still often used. One modern application is for lighting a gas flame. When you push a button, a small weight hits a piezo-electric block, which in turn generates several thousand volts. This causes a spark that lights the flame.

In the crystal or ceramic mike, the diaphragm is coupled to the piezo-electric material so that the sound vibrations move the block; this in turn generates an electric voltage that is proportional to the sound signal. The mike can generate a volt or so of audio, though only at a small current.

Crystal and ceramic mikes are somewhat fragile, but back in the days before inexpensive IC amplifiers were available, they were popular because their output didn't need much amplification to be useful. But today's integrated circuits provide lots of cheap gain, so the most popular contemporary mike is the dynamic microphone.

Dynamic mikes work on the same principle as electric generators in power plants or even in your car: When a coil of wire is placed in a changing magnetic field, the coil generates a voltage. This can be done in two ways --- either keep the coil stationary and move a nearby magnet, or else keep the magnet stationary and move the coil.

Since the coil is usually lighter and smaller, it's more common to move the coil. In the dynamic mike, the diaphragm is attached to the coil, and the magnet is stationary. When the diaphragm vibrates, the coil moves in relation to the magnet, and thus produces a small voltage.

Dynamic mikes and dynamic earphones have much in common, since the earphone can work as a mike, and the mike can work as an earphone (except that the earphone usually isn't rugged enough to produce much sound). For instance, Figure 3 shows the earphone from a typical telephone. In this case, an electric current through the coil (which is called the *voice coil*) produces motion. The voice coil is attached to a diaphragm that then vibrates and produces sound. Modern speakers have a similar construction, except that the diaphragm is much larger and is called the *cone.*

As I mentioned above, dynamic mikes and earphones work in both directions. For example, some years ago, after placing a call from a pay phone, I discovered that someone had apparently stolen the mike from the handset. By yelling into the earpiece, I was able to complete my call anyway. But since dynamic mikes (and earphones!) produce much less output than a carbon mike, even with yelling my signal was very hard to hear.

Dynamic mikes can produce very good sound quality, mainly because the mass of the diaphragm and attached coil is very small, and so they easily vibrate in step with the sound wave. Since the vibrations of sound occur very rapidly, a heavy diaphragm cannot move fast enough to accurately reproduce these sound waves. A carbon mike is worse, since it has to move a lot of carbon granules. A crystal or ceramic mike is better, but it still has to apply some force to the piezo-electric material and this increases the mass. A dynamic mike is an even greater improvement because the diaphragm and coil can be very light. The best mike would be one in which there is just a diaphragm, and nothing attached to it at all. There is a form of a dynamic mike, called a *ribbon microphone,* in which the diaphragm is actually a thin strip of foil acting as the coil. But these mikes are very fragile (a strong wind can ruin the foil) and also provide a tiny output, and so they are not very common.

Instead, professional recording studios often use an excellent (though very expensive) mike called a *condenser microphone.* In the condenser mike, the diaphragm acts as one plate of a capacitor. As it moves, the capacitance changes, and an amplifier picks up that change and converts it into a voltage change.

Condenser mikes require a power supply, partially to charge up the capacitor, and partially to power an amplifier right inside the mike. The amplifier is needed because the condenser mike output voltage is tiny, and so it has to be amplified right inside the mike before being sent out the cable. Professional recording studios usually have a 48-volt power supply inside the recording console to supply power to condenser mikes.

The cheap modern version of a condenser mike is the *electret microphone.* These mikes work on the same principle as older condenser mikes, but the diaphragm is made out of a permanently charged semiconductor material that does not need a separate power supply. There is still an amplifier inside the mike, but the amplifier needs only a volt or two to run and so can be powered by a single battery. Electret mikes are not as good as professional condenser mikes (since their diaphragms are heavier), but they are cheap and small. Radio Shack has some electret cartridges for $2; these cartridges are often found inside small cassette recorders. When you buy an actual electret mike, most of its cost is in the case and hardware, since the cartridge inside is often the same $2 cartridge (even cheaper in larger quantities).

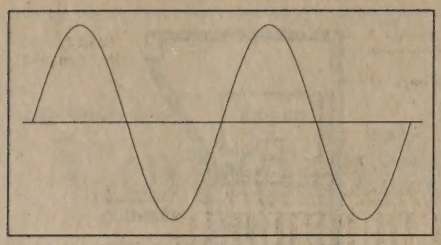

Figure 4. Waveform of a whistle.

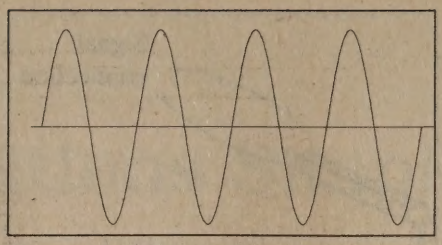

Figure 5. Whistle waveform an octave higher than that in Figure 4.

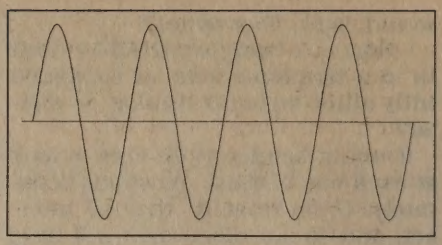

Figure 6. More complex musical sound.

one place to another, and then converted back into air vibrations by a loudspeaker. Both the microphone and the loudspeaker (more often just called the speaker) are called *transducers*, a term describing any device that converts energy from one form (such as mechanical vibration of the air) into another (such as an electrical signal). (See Detour 1.)

In simple sounds such as someone whistling, the resulting waveform may be a sine wave; in more complex sounds the waveform may be much more complex as well.

Let's now look at the output of a microphone on an oscilloscope. What you see depends on the sound that the mike is picking up.

Suppose you stand in front of a mike and whistle a pure note into it (making sure to be far enough away so the mike isn't picking up the sound of the air hitting its front). You'd see the signal shown in Figure 4. This kind of a wave is called a *sine wave* because of its relationship to the sine function from math.

On the other hand, suppose you whistle another note, but this time an octave higher. The word *octave* is a musical term, meaning eight white keys lower on a piano keyboard. This time you'd see the waveform of Figure 5.

Both of these waves have the same shape, but the second one goes up and down twice as often as the first. In electronic terms, its frequency is twice as high. More on this in a moment.

Now suppose you do the same thing, but this time look at the signal created by the sound of some instrument such as a trumpet, rather than a whistle. Figure 6 shows the resulting picture.

The sound in Figure 6 has the same frequency as that in Figure 5 (since it has the same number of cycles in a given time period), but it looks very different. A musician might say that it has the same *pitch* (that is, it is the same musical note), but different *timbre* (a different sound quality). Some repetitive sounds (like the pure tone of a flute) have a waveform almost like a sine wave; other repetitive sounds (like those from a violin or trumpet) have a waveform possessing a basic frequency, but which looks much more distorted and "kinky" than a sine wave.

The frequency of a note determines the pitch; two different instruments playing the same note have the same frequency. But they sound different because their waveshapes are different. Finally, note that the amplitude of the wave—its height—determines its volume. Quite often the amplitude of the waveform changes with time. For example, when you play a piano note, the amplitude builds up to a maximum fairly quickly when you hit the key, but then gradually decreases as the note dies away.

Note also that only repetitive sounds (like a whistle or the note of a guitar) have a definite frequency; other sounds (like the beat of a drum or the crack of a whip) do not.

Sound normally involves frequencies from about 20 to about 20,000 Hz, but many people cannot hear that entire range. Children often hear up to almost 20,000 Hz; as you get older, you hear fewer and fewer high frequencies. When you reach 60 or 70 years of age, you will be lucky if you can hear up to 10,000 Hz. On the other hand, many animals (such as bats or dogs) can hear much higher frequencies than humans can.

Figure 7 shows the frequencies produced by each of the white keys of a piano. For example, if you look at the note labeled "Middle C," you will note that its frequency is 261.6 Hz. If you then go an octave to the higher—counting exactly eight notes to the right—you get to the next C, which is at 523.2 Hz, exactly twice the frequency. The piano has about an eight-octave range, and its frequencies range from about 27 Hz on the left or bass end, up to almost 4,200 Hz at the right or treble end. Figure 7 also shows the frequencies produced by various other instruments. For example, the trumpet produces notes only in the range from about 160 Hz up to about 890 Hz.

That brings up an interesting question: If the frequencies of musical notes range up to about only 4,200 Hz (and most musical instruments have even less of a range), why do hi-fi equipment manufacturers stress that their equipment goes up to 15,000 or even 20,000 Hz? The answer has to do with harmonics.

Harmonics or Overtones
So far, we've explained that

(1) The frequency of a sound determines its pitch or tone, and two instruments playing the same tone will have the same basic frequency. That basic frequency is called the *fundamental.*

(2) The amplitude of the sound determines its volume.

(3) The waveshape of the sound is

DETOUR 2

Let's talk about filters for a moment. Suppose you get several pieces of colored glass—one red, one green, one blue. When you look at a light bulb through the red glass, you see red light. Look through the green glass, and you see green light; look through the blue glass and you see blue light.

Don't think of the colored glass as a filter that is *changing* the white light into colored light. Instead, remember that white light consists of many colors, all combined together. The colored glass is simply a filter letting one color through, while stopping all the other colors. We can demonstrate that easily be putting the green and red glasses together and trying to look through both of them. When the white light goes through the red glass, only red light comes out. There is no green light left, and so when that red light hits the green filter, it is all stopped and nothing comes out (assuming that the filters are good enough).

If we have light from some unknown source, colored glass filters let us test that light to see what colors are in it. If we use a particular color glass, and nothing comes through it, then we know that that particular color was not generated by the unknown light source. But we can also interpret this result in a different way: if what comes out of the glass filter is different from what went in, then the original light must have had some colors in it that did not pass through the glass.

In the same way, electronic filters, like those in Figure 9, let us test an electrical signal to see what its components are. When we put a 1,000-Hz square wave into a 1,000-Hz filter, but a sine wave comes out, this tells us that the original square wave must have some other frequencies in it that cannot get through the filter.

what gives it its tone quality. For example, a trumpet or violin can play the same note, but they will have totally different waveforms; that is what makes them sound different.

Consider, for example, a square wave like Figure 8. What is it that makes this wave different from a sine wave?

Suppose this square wave has a frequency of 1,000 Hz. An interesting thing happens when we send it through some tuned bandpass filters—that is, filters that let through only one frequency. This is shown in Figure 9.

When the 1,000-Hz square wave is sent through a 1,000-Hz filter, out comes a 1,000 Hz sine wave! Nothing comes out of the 2,000-Hz filter, while a small 3,000-Hz sine wave comes out of the 3,000-Hz filter. What's going on!?! (See Detour 2.)

Returning to Figure 9, we have three filters all looking at the same original 1,000-Hz square wave. We see three things:

- The 1,000-Hz filter outputs a 1,000-Hz sine wave, so there must have been a 1,000-Hz component in the square wave.
- The 2,000-Hz filter outputs nothing; thus, there was no 2,000-Hz component in the square wave.
- The 3,000-Hz filter is also outputting a signal, and we see that it has three times the frequency of the square wave (there are three times as many cycles in the same amount of space); so it seems to be at 3,000 Hz. Moreover, if we were to measure it carefully, we would see that it is exactly one-third the height of the 1,000-Hz sine wave.

If we had more filters, we would see other frequencies as well. Any filter tuned to an odd multiple of 1,000 Hz would show an output, while any other filter would show nothing coming out at all. For example, if we had a filter tuned to 5,000 Hz, out would come a small 5,000-Hz sine wave, and so on.

We can see from this that a 1,000-Hz square wave consists of a large number of components. The 1,000-Hz sine wave is called the *fundamental,* since it has the same frequency as the original square wave. Each of the other components is an exact multiple of the fundamental; the frequency of the 3,000-Hz signal is exactly three times the fundamental frequency, and is therefore called the *third harmonic;* the 5,000-Hz component has a frequency of five times the fundamental, and is therefore called the fifth harmonic. In other words, a square wave consists of a fundamental sine wave signal (whose frequency is the same as that of the square wave), plus a large number (actually an infinite number) of extra frequencies, each of which is an exact odd multiple of the fundamental. We say that the square wave consists of a fundamental plus an infinite number of odd harmonics.

Figure 10 shows a computer simulation of this situation. It shows a fundamental plus four harmonics (the third and fifth are labeled; the seventh and ninth are not), each of which contributes a little to the output. When they are all added up, we get the wave that looks square shaped, except that its sides don't go straight up and down, and the tops and bottoms are not quite completely flat. The reason it only approximates a square wave is that it has only a limited number of odd harmonics, whereas a perfect square wave requires an infinite number of them.

This is an important concept to understand: The square wave consists of an infinite number of components. Of course, the components have to be just right—they must have the right frequency, the right amplitude, and even the right phase. For the square wave, the rules are fairly simple:

- The harmonics must be exact odd multiples of the fundamental frequency. For example, the 93rd harmonic of a 1,000-Hz fundamental would have to be *exactly* 93,000 Hz.
- Their amplitude must be just right. For example, the third harmonic must be exactly one-third the size of the fundamental; the fifth harmonic must be exactly one-fifth the fundamental's size, and so on, all the way up. Thus the 93rd harmonic would have to be 1/93 the size of the fundamental. This points out that eventually the harmonics get so small that perhaps they can be omitted without making a noticeable difference in the square wave.
- Their phase has to be just right. To get the steep rise and fall of the square wave, all of the sine waves making it up have to go up together, and down together, as shown at points *a* and *b* in Figure 10. If any one of them is out of step, the result will be some wave other than a square wave.

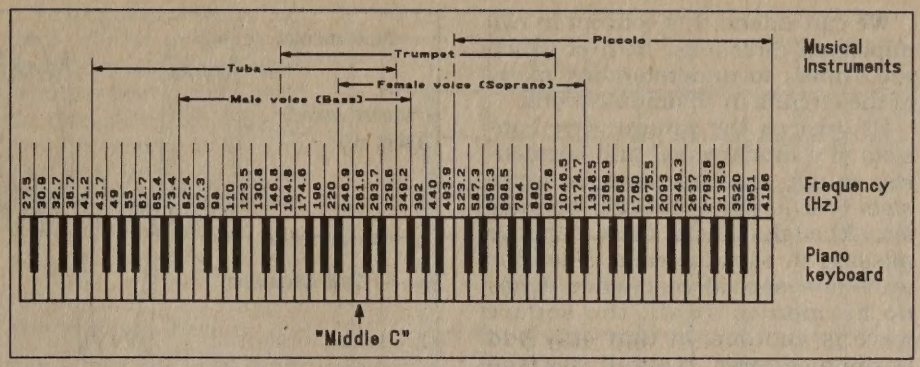

Figure 7. Frequencies produced by musical instruments.

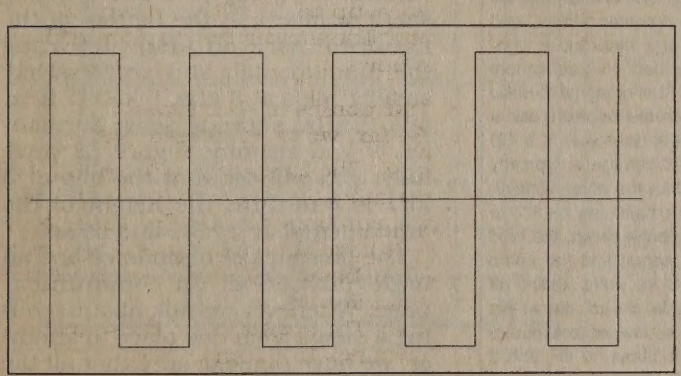

Figure 8. A square wave.

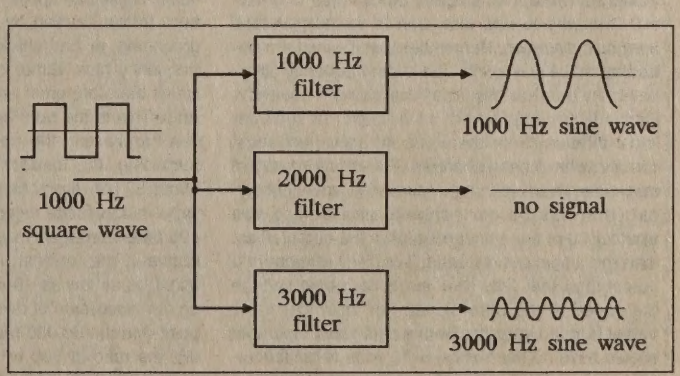

Figure 9. Separating a square wave into components.

We can extend this concept in two important directions, both of which are critical to understanding many of the circuits in communications:

(1) Just as the square wave consists of a fundamental and harmonics, so *any repetitive waveform consists of a fundamental and harmonics*, although some of these might be missing in special cases. The sine wave is a special case since it has no harmonics at all; the square wave is another, in that only odd harmonics exist, they all rise and fall together, and the harmonics get smaller as their frequency rises. In a more general case, there might be both even and odd harmonics, some harmonics might be large and others small or missing, and they might have all sorts of strange phase relationships. You may have heard of the FFT or Fast Fourier Transform; it is simply a mathematical procedure for finding out what components make up any particular waveform.

(2) No matter how you generate that waveform, the harmonics are there even if you don't consciously put them in. For example, one way to generate a square wave is to set up a switch that rapidly switches between a positive and a negative voltage. This setup obviously doesn't put in any sine waves, yet if you look at the square wave with some tuned filters, the fundamental and harmonic sine waves are there.

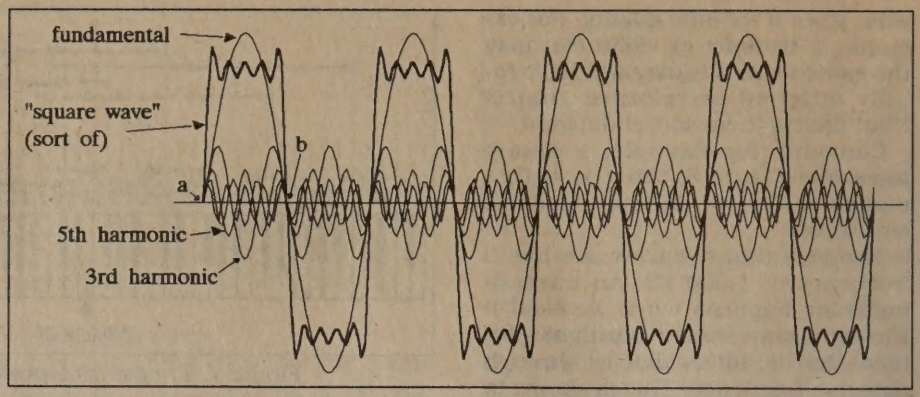

FIGURE 10 needs a caption. there were two figure 9s.

Let's think about filters again. A filter lets you look for specific frequencies (or colors) in a signal (or in light). But using colored filters to look for specific colors in light is a hit-or-miss proposition if you don't know what to look for; you might need many specific color filters to identify the components in a particular light source. You can save a lot of time by looking at the light through a prism, which lets you see all the color components at the same time in the form of a rainbow or *spectrum*. The prism acts like a very large number of filters, all working together to check all the colors at the same time. You can then immediately spot whether a given color is in the light, or whether it is missing.

In communications there is an instrument that does the same job. Rather than looking at a signal through filters that look at just one frequency at a time, we can use a *spectrum analyzer* to break down a signal into its components and display them all on a scope screen as a *spectrum* (notice the similarity to the use of the word in referring to a spectrum of color).

The spectrum analyzer measures the frequency components in a signal and plots the voltage of each component against its frequency. For example, if you were to look at a pure 1,000-Hz sine wave on the analyzer, you'd get a picture like Figure 11.

If you imagine that 0 Hz is on the left of the screen, and each division to the right represents 1,000 Hz, then the "blip" toward the left would be at 1,000 Hz, and (in this case) have a height of 7 divisions. (Ideally, the blip would be just a thin line, but on the spectrum analyzer it is spread out so it looks like a very tall but thin bell.)

Leaving the analyzer at the same setting, Figure 12 shows the spectrum of a square wave. This time there is a big blip at 1 kHz (I added small numbers at the bottom of the figure to mark off kHz) indicating the fundamental, and progressively smaller blips at 3 kHz, 5 kHz, 7 kHz, and 9 kHz, showing some harmonics. If you examine Figure 12 carefully, you will see that the blip at 3 kHz is one-third the height of the fundamental at 1 kHz, and so on.

The presence of harmonics has an important effect on communications. Whenever we talk about sending a signal from one place to another, we have to make sure that all the components of that signal (or, at the

DETOUR 3

While we're on the subject of hi-fi equipment, let's discuss a few more terms.

It's not enough for a piece of hi-fi equipment to cover a wide range of frequencies; different frequencies in the range have to be treated equally. That is, an amplifier or tape deck that covers 20–20,000 Hz, but provides a lot less gain above, say, 1,000 Hz than below, would sound very bassy. Ideally, hi-fi equipment should be able to handle signals of different frequencies equally well. Evenness of response is usually rated in *decibels* or dB. For example, a typical amplifier might have a rating of "20–20,000 Hz +/-1 dB," which means that the gain (how much it amplifies) does not vary more than plus or minus 1 decibel from some midscale value. (We'll have a detour later to explain decibels.)

In addition to having a wide frequency range, the hi-fi device also should not distort the signal. That is, its output waveform should look like the input waveform (except for possibly being larger or smaller). One way to rate distortion is as THD or *total harmonic distortion*. Remember that it's the harmonics that make one signal of a given frequency different from another signal of the same frequency. Hence if the output from an amplifier or recorder looks different from the input, its harmonics must somehow have been changed. The standard way of measuring this is to insert a pure sine wave test signal (that has no harmonics), and look to see whether there are any harmonics in the output. If so, then the signal got distorted. The THD number is a percentage that tells how much harmonic voltage got added to the pure signal. For instance, if the output from an amplifier (with a sine wave input that should have no harmonics) is 10 volts of fundamental and 2 volts of harmonics, then there would be 20% THD (a terribly high number, by the way. THD values of under one or two percent are more desirable).

Actually, though, harmonic distortion is not nearly as bad as you think. Since music and speech normally have harmonics anyway, adding an extra percent or so of harmonics to them is not too noticeable. Amplifiers and other all-electronic hi-fi equipment tend to have low distortion, but tape recorders and mechanical components such as phonograph cartridges and speakers often have a high THD (sometimes as much as 5% to 10% for speakers).

Much more dangerous is IM or *intermodulation distortion*, which introduces new frequencies not in the original at all. Even 1/2% or 1/4% IM distortion is grating and unpleasant. Unfortunately, IM distortion is not very often listed in spec sheets for equipment; fortunately, however, IM distortion sort of goes hand in hand with THD, and a hi-fi device with low THD *probably* also has low IM.

Finally, hi-fi equipment should have very little noise. Noise can appear in the form of a low-pitched hum (often caused by a bad power supply, bad grounding, or bad shielding of a wire) and a high-frequency hiss. Either one is bad. Hi-fi equipment specs therefore often list the SNR or *signal-to-noise ratio*. This is the ratio between the loudest music it can handle and the noise. For example, in a CD recording, the loudest music voltage is typically about 65,000 times higher than the noise voltage, while in a cassette recording it might only be 300 or 400 times stronger. In a telephone circuit, the ratio between the loudest voice signal and the noise might be as low as 10 to 1. Since we're holding off on our discussion of decibels, let me just say at this point that the 65,000 ratio is equivalent to about 95 dB, the ratio of 300 to 400 is about 50 dB, and a ratio of 10 is only about 20 dB.

very least, the *important* ones) get through as well. This brings us to the concept of bandwidth.

Bandwidth

Consider piano music. Obviously having a phonograph that covers the range from 27 Hz to about 4,200 Hz will let through all the notes, allowing us to recognize the melody.

But a restricted range like that does not sound like a very good piano. To make it sound realistic, you must let through all the harmonics—or at least the ones you can hear. That is why modern hi-fi equipment typically reproduces up to 20,000 Hz (or, at least, that's what the manufacturers claim!) In fact, 15,000 or even 10,000 Hz would probably do for us older people whose hearing no longer extends to 20,000 Hz (pity!)

Let's look at the frequency ranges covered by various pieces of equipment:

- SSB transceiver—about 300–2,700 Hz.
- Telephone line—about 300–3,500 Hz.
- AM broadcast station—about 100–10,000 Hz.
- FM broadcast station—about 50–15,000 Hz.
- Compact disk—about 5–20,000 Hz.

Looking at these frequency ranges, we can clearly see which equipment will handle music best, and which is merely good enough for voice. (See Detour 3.)

So far, we've taken a short look at the nature of audio. We have seen that audio signals consist of frequencies in the range of about 20 Hz to about 20,000 Hz, but that a narrower bandwidth suffices if we're not too concerned with quality. For example, a typical telephone circuit can handle only the range of about 300 Hz to about 3,500 Hz.

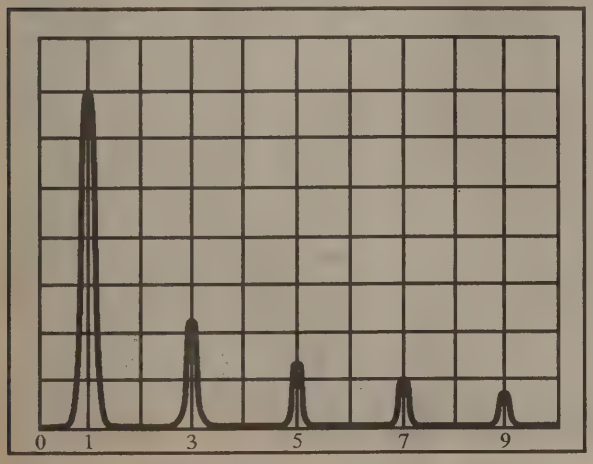

Figure 12. Spectrum of a 1,000-Hz square wave.

A frequency range up to 3,000 Hz or 4,000 Hz is good enough to understand speech and even to recognize the voice of the speaker, but it is certainly not hi-fi. Let us now look where time comes into this.

Time

Let's say you have a friend somewhere in the Far East, and you want to speak with him for a long time. But at the rate of perhaps $1 per minute for a phone call, you hesitate. So you come up with the following scheme:

Say you have 20 minutes of things to tell him. You decide to record it on tape at a low speed. Then you rewind the tape and play it back, but at double the speed so that it takes only 10 minutes to play. Can you thus send 20 minutes of speech, but pay for only a 10-minute phone call?

> "The presence of harmonics has an important effect on communications."

You can certainly do that, but your voice will sound like the Chipmunks (that's how they do their voices!) and may not be too understandable. But suppose your friend records your voice on another tape recorder, but this time records at high speed and plays it back later at half-speed (try this with a Chipmunks record!) This stretches the 10 minute tape back into 20 minutes. Will this work? (And if it does, can you speed up the tape by a factor of 10 and pay for only a 2-minute call?)

Yes . . . and no. What happens is that as you double the speed of your tape, every frequency on the tape gets doubled too. A 1,000-Hz component of your voice becomes 2,000 Hz, and so on. The problem is that every component of your voice that is above 1,750 Hz or so gets doubled to above 3,500 Hz, and therefore doesn't make it through the phone line. In other words, your friend will only hear those components in your voice that are below 1,750 Hz. (And if you tried to speed things up by a factor of 10, he would only hear those parts of your voice that are below 350 Hz.)

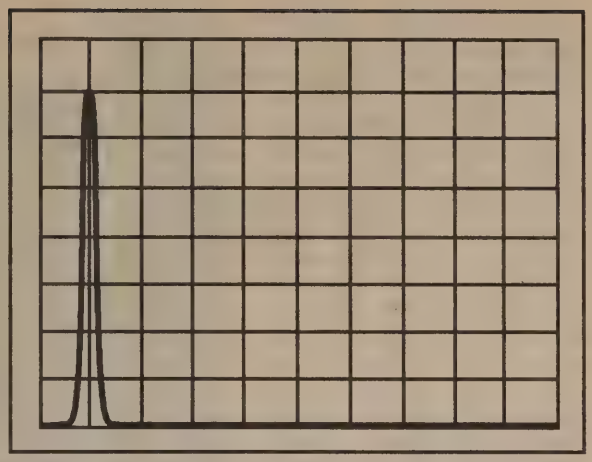

Figure 11. Spectrum of a 1,000-Hz sine wave.

In other words, it's the bandwidth of the telephone line that limits how much information you can get across in 10 minutes. If you used a higher-bandwidth line—such as the special lines that broadcast stations lease from the phone company for studio-to-transmitter links, which cover up to 10,000 or 15,000 Hz—you could easily speed up your tape by a factor of 3 or 5, and still transmit all of your message (though still only at normal telephone-line quality).

So the idea is that there is a tradeoff between bandwidth and time. If you have a fixed amount of information to send, you can send it fast if you have a lot of bandwidth. But you have to send it more slowly if the bandwidth is small. That explains why, for example, a fax transmission can go through a regular telephone line, but a full-motion TV video image can't. The fax takes up to a minute to send one picture, whereas the TV has to send it in 1/30 of a second.

Summary

Although the discussion has rambled off and on about various aspects of audio, we've actually covered a lot of ground. We have seen the characteristics that make up an audio wave—the frequency, wave shape, and amplitude of the signal. We have looked at how harmonics affect the wave shape, and how the bandwidth of a system affects the sound quality that you can send through it. Next time we will tackle transmission of video. RF

Marconi Celebrated by Midwestern College and Amateur Radio

The Hundredth Anniversary Celebration

Paul Marsh NØZAU

In 1895, Guglielmo Marconi began his experiments which led to wireless communications. In 1995, Metropolitan Community College of Omaha Nebraska, amateur radio organizations in Nebraska and Iowa, Omaha's Western Heritage Museum, the Historical Society of Douglas County and others gathered to celebrate the 100th anniversary of Marconi's work." So begins the QSL card of the Marconi Telecommunications Fair in Omaha Nebraska, which took place May 20–28 on the campus of Metropolitan Community College. Recognizing the important role he played in the development of radio, was named honorary chairman of the event, and a souvenir QSL card was printed for the occasion.

The College's president, Richard Gilliland W5VTS, and the college's director of instructional resources, Paul Marsh NØZAU, determined that the college should note the centennial by showcasing wireless communications and the amateur radio community. One of the college's campuses is located on historic Fort Omaha, a retired military property. Centrally located on that property is a 16-acre parade ground, which became base for an antenna farm the average ham wouldn't ordinarily have the space to construct.

With the help of college staff, amateurs from several ARCs in and near Omaha assembled and erected a 5 1/4-wave 20-meter rhombic antenna, a 160-meter dipole, and a long-wire antenna about 500 ft long. The college erected also a tent-like shelter, placed a plywood floor inside, and provided lights and power. The facility was open 24 hours a day for the entire week. Local amateur clubs included the Ak-Sar-Ben ARC of Omaha, Southwest Iowa ARC of Council Bluffs, Iowa, Pioneer ARC of Fremont, Nebraska, and Bellevue ARC of Bellevue, Nebraska.

A number of hams brought radios, antenna tuners, and other equipment, and a number of folks spent long hours overnight chasing those elusive foreign contacts. Several hundred confirmed contacts from the US, Canada, and more than 30 other countries were made during the week.

Special events included a visit from students at local elementary schools. They talked with amateurs across the world, learned how their names sounded in Morse Code, saw themselves on ATV, toured the local Red Cross chapter's communications van, watched packet radio work, and had a great time. John Gebuhr WBØCMC, manager of the local ATV repeater, surprised all involved when he patched the ATV signal from Fort Omaha into the newsroom of WOWT, the local NBC TV affiliate. The local news anchor then called Fort Omaha on the local 2 meter autopatch, and the school kids had the thrill of seeing and talking to a "real TV star."

Historical Exhibits

Two historical agencies provided important exhibits. Since Fort Omaha was an important US Army Signal Corps training facility before and

Photo A. Students from Omaha's Miller Park Elementary School gather in the shelter to learn about amateur radio.

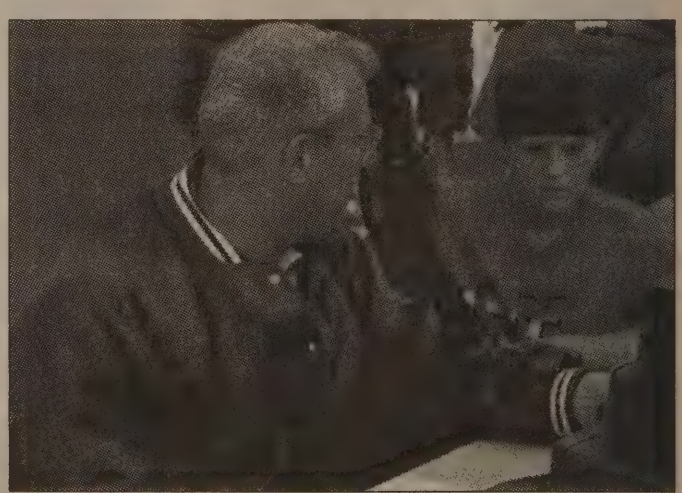

Photo B. Jerry Gross WA6POZ demonstrates an HF radio to a student.

during the First World War, the Historical Society of Douglas County mounted an interesting exhibit on the history of communications at the Fort Omaha's Western Heritage Museum, home to a wonderful collection of radio and communications equipment, exhibited radios and other artifacts dating back to the 1920s. These items are part of the museum's collection that was assembled by Leo Meyerson from his days at World Radio Labs.

The college itself provided exhibits of modern communications gear, and the electronics Department's faculty informed visitors how to begin careers in communications and electronics.

The second weekend included a flea market on one of the college's parking lots. In the great Dayton tradition, Mother Nature provided about two inches of rain that day to keep the hot bargaining at a reasonable level.

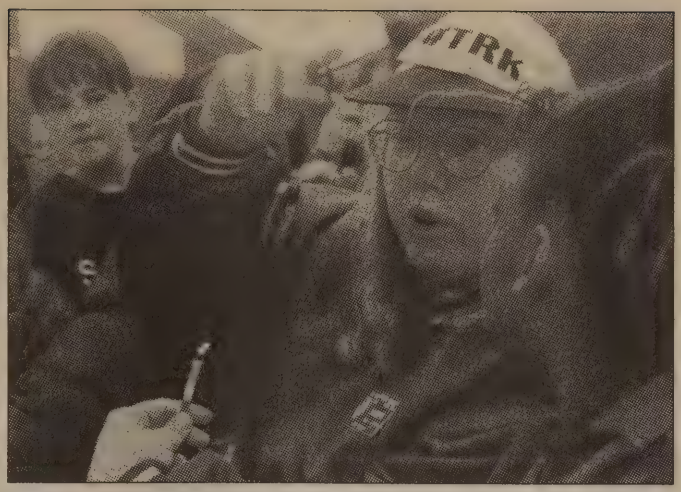

Photo C. Mary Joseph WØTRK, president of Ak-Sar-Ben ARC of Omaha, shows elementary school students how amateur radio works.

Leo Meyerson WØGFQ

In keeping with the historical nature of the event, Gilliland and Meyerson sat down and conducted a 45-minute reminiscence of Leo's life and career. Leo recounted how he got into the radio business, how the Globe and Galaxy radios were developed, how he came to know such radio greats as Lee DeForest and David Sarnoff, and how his company helped the World War II mobilization efforts.

Several hundred people visited Metropolitan Community College and the Marconi Telecommunications Fair. All were pleased, and several expressed interest in learning more about amateur radio. The local club training officers were on hand, and not coincidentally had information packets about a beginners' amateur radio class to begin two weeks later.

Events like this are good examples of how amateur radio and other resources in the community can work together for their mutual benefit and for the education of the public. The enjoyment of the hobby, the potential for careers, and awareness of the historical resources of the community were brought together in Omaha 100 years after Guglielmo Marconi started it all. RF

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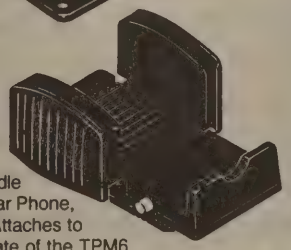

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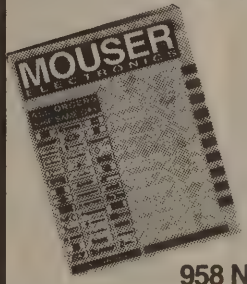

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1, 2, 4—A Geometric Progression That You'll Love

by Edward Oros AC3L

Confused? Let me give you a little hint. 1 foot, 2 meters, 4 dB. Any guesses yet . . . ? Give Up . . . ? Okay, it's the specs for a 2 meter beam. Actually it's a "TINY 2" meter beam. The elements are spaced a mere 1' apart (center to center). The design covers all of 2 meters and it provides 4 dB gain over a dipole. The 4 dB is like taking a 50-watt signal and cranking it up to over 100 watts output. And that's not all! It's also a direct connect antenna; in other words, you hook your radio to your 50-ohm coaxial cable and the coax is connected directly to the antenna (my favorite method of feeding any antenna!). There is no time wasted fooling around with matching because the SWR is already less than 1.5 to 1 across the 144–148 MHz band. If you've never attempted to build a beam before now, this is a great one with which to start.

Materials

The material requirements are simple: 6 feet of 1" diameter aluminum tubing (see the side bar for the exact lengths of the elements); 10" of PVC pressure pipe (inner diameter of 1"); four U-Bolt clamp brackets (Radio Shack 15-826 or equivalent); two screws (3/4"); four furniture end tips (1" variety; however, the tips are optional); and a boom, 1' 4 " long (metallic or otherwise).

"If you've never attempted to build a beam before now, this is a great one with which to start."

Construction

Position the director near the end of the boom, center it, and attach it. If you have your own favorite construction techniques, feel free to be creative. But if this is your first time, let me just say that connecting the elements to the boom can be an easy process. Use two brackets over each element, one on each side of the boom. Instead of placing the clamp on a single U-bolt, place one side of the clamp on one U-bolt and the other side of the clamp on the opposite side of the boom on the other U-bolt. Then screw on the nuts and tighten. Do this for each set of U-bolts (see Photo A). Once the director is mounted, take the PVC pipe and mark the center point (5"). Now measure 1/4" on each side of this point and drill a hole big enough for the screws at each mark (do this on the side *opposite* to the writing, if any exists on the PVC pipe). Insert the driven elements into the pipe—one on each side—and watch for the metal to pass the hole. As soon as the metal covers the entire hole, stop inserting. Drill the hole out again and insert the screw. Then do the same for the other hole. Verify, with an ohmmeter, that the two sections of the driven element are not electrically shorted. Next mount the PVC pipe on the boom exactly 1' from the center of the director element (see Photo B).

Note: The boom can be either conductive or nonconductive. But

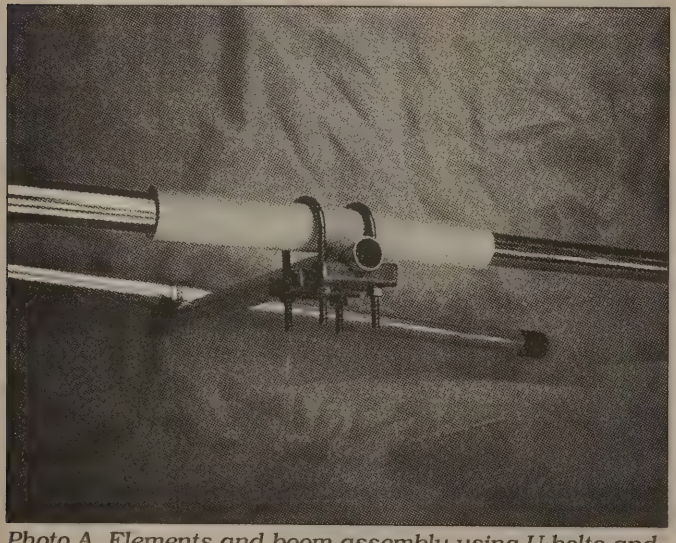

Photo A. Elements and boom assembly using U-bolts and clamp.

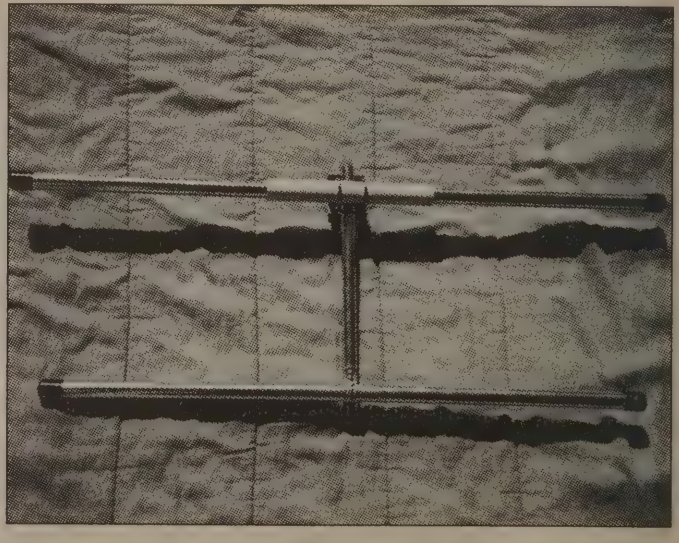

Photo B. Overhead view of completed assembly.

when using conductive material, be sure the driven elements are kept isolated from it.

The last step is to attach your coax cable directly to the screws. Do not use jumper leads from the coax to the screws; just trim the cable back enough so that you can loop the center lead around one screw and the shield around the other one. If you have a 2 meter balun, all the better, but I think you'll find it performs fine even without one.

Putting It up

Offhand I can think of three ways to attach the mast to the boom. First you can extend the boom a few feet out behind the driven element and attach the mast there. A second method is to use a nonmetallic mast. In this case you can attach it anywhere between the elements on the existing boom. Lastly, if you choose to use a conductive mast and you want to keep the boom short, mount it exactly mid-

"Well, for the nonbelievers, let it be known that even *indoors*, I was able to copy repeaters out of Ohio from my western Pennsylvania QTH. Not bad for a 1-foot beam!"

way between the driven and director elements. This will reduce the interaction between the various components.

Does It Work?

I had my Tiny 2 at a recent hamfest and you should have heard the snickers I was getting from some people. There were comments about how you wouldn't be able to talk to anyone with it outside your own township! What a lot of people fail to realize is that the majority of the gain you obtain from a beam occurs with the first two elements! Going to a three-element version of the same antenna provides only about 2.5 dB more gain over the Tiny 2!

Well, for the nonbelievers, let it be known that even *indoors*, I was able to copy repeaters out of Ohio from my western Pennsylvania QTH. Not bad for a 1-foot beam! RF

Ten-Tec 1056 Receiver Kit

Continued from page 5

IV. Solder all wires or pins.

V. Trim all wires or pins.

Soldering should not be the big mystery it seems to some people. Without going into great detail, here are some guidelines. A 15- to 30-watt soldering pencil with a fine point is adequate for most PC board work. Use rosin-core solder. *Rosin-core!* Use a small-diameter solder tip. Use as little solder as possible. Keep everything clean. Heat the joint, not the solder. Learn on something besides the kit you bought with your lunch money.

I found assembly to be very straightforward, with no surprises. What the heck! There are only 59 assembly steps. The only discrepancy I found was on the schematic: D2, which is installed across the R2 main tuning pot, is not shown. The 1N753A zener is in the parts bag, shown on the X-ray view of the board and included in the assembly instructions. No problem!

There are a couple of jumpers on the board that were purposely designed in. JM1 allows some flexibility with the power supply and J2 could be replaced by switch or relay contacts if you decide to use the 1056 as something other than a simple receiver. Also on the board are pads for sidetone injection and oscillator output. Hhmm? Digital readout? A 30 meter handheld?

At Step 33 you can perform an optional test of the audio system.

Steps 34 through 51 involve installation of the NE612/U1 and its support circuitry, common to all bands. Then comes the hard part: choosing which of the nine available bands you want to use. You probably won't want to use your soldering iron as a band switch, so some thought is in order. I wired mine for 30 meters because, even with the bands as flaky as they are right now, 30 seems to be pretty good. Besides, I don't have any gear that tunes any of the WARC bands. I'm kind of a throw-back, I guess.

The kit is fun to put together, produces a usable receiver, and is probably a good place for a newcomer to get started in kit building.

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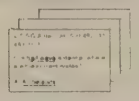
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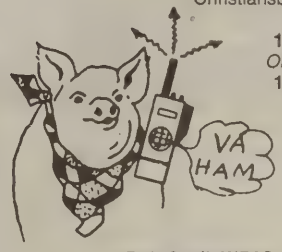

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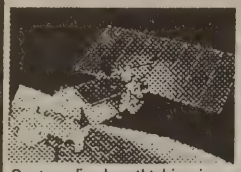

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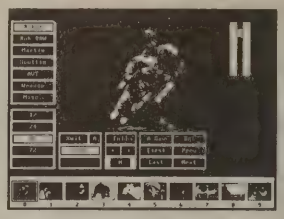

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FNB35SS,	7.2v	@	1500mAh
FNB38,	9.6v	@	600mAh

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You get excellent gain for solid, noise-free QSOs. On 440 MHz, it's a high gain ½ wave over ¼ wave radiator. On 2 Meters, it's a *full size* ¼ wave radiator.

Its tough *stainless steel* radiator is only 19 inches tall -- won't knock off when parking in your garage.

An extra powerful magnet holds it steady -- even at highway speeds.

You get 15 feet of coax with a standard PL-259 coax connector for your mobile rig.

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Your MFJ-1724B is protected by MFJ's famous one year *No Matter What*™ unconditional guarantee.

DualBand144/440 MHz Ground Plane

MFJ-1754
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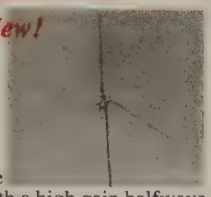

Dual band ground plane antenna for 2 Meters and 440 MHz gives you extra long range on 440 MHz with a high gain halfwave over quarter wave radiator. On 2 Meters you get solid quarter wave performance. Mounts on 1 to 1½ inch mast with single U-bolt. Easy-to-tune.

1/4 Wave Ground Plane

MFJ-1740
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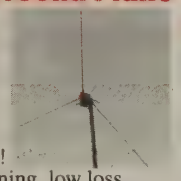

The MFJ-1740 brings up 2 Meter repeaters as well as any ¼ wave ground plane made!

You get easy tuning, low loss ceramic antenna insulator and strong lightweight aluminum construction.

Single U-bolt mounting for 1 to 1½ inch mast. Cutting chart included for 220/440 MHz. Made in USA.

MFJ Pocket Roll-Up™

2 Meter halfwave J-pole antenna

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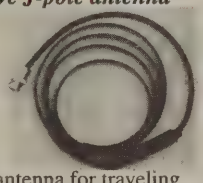

Roll up this *halfwave* 2M J-pole antenna and stick it in your pocket! It's the perfect *gain* antenna for traveling.

Get home station performance on the go. Just hang your *MFJ Pocket Roll-Up*™ in the clear and plug the BNC connector into your handheld.

It's omni-directional and has significant gain over a ¼ wave. It does not need a cumbersome ground plane so it's convenient for indoors and works great with handhelds. Made in USA

Dual Band *flexible* Ducks

144/440 MHz flexible ducks for HTs

A. High Gain FlexiDuck™. **MFJ-1717, $19.95.** Enjoy dependable QSOs when other rubber ducks give you noise. High gain ½ wave on 440 MHz, full size ¼ wave on 2M. Won't jab you -- bends, twists, flexes with you. 15¾ inches.

B. FlexiDuck™, **MFJ-1716,** A. B. **$16.95.** Similar to MFJ-1717. Full ¼ wave on 440 MHz, efficient loaded ¼ wave on 2 Meters. 8¾ inches.

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Add this *short*, 4¼ inch *ShortyDuck*™ to your 2M handheld for a Q-5 signal! Impedance matched for maximum gain. High-Q helical wound radiator.

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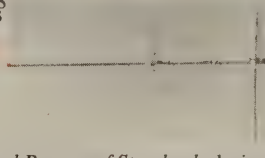

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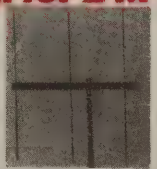
Portable 3 element Yagi for 2 M

MFJ-1763
$39.95



You can set up or take down MFJ's *portable* 3 elements 2 Meter Yagi in seconds! Elements simply screw into the boom.

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Telescoping antennas for handhelds

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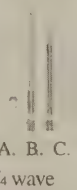

A. B. C.

B. Dual Bander™ for 2 Meters and 440 MHz, **MFJ-1712**, $14.95. Got a new dual band handheld or separate units? One antenna fits all. It's a ¼ wave for 2 Meters and a ⅝ wave with gain for 440 MHz. 7¼" collapsed, 19" extended.

C. Pocket Linear™ ⅜ Wave, 2 Meters, **MFJ-1710,** $9.95. Carry this pen size antenna in your pocket like a ballpoint pen. When you're using your rubber duck, on the fringe and noisy, put on the *Pocket Linear*™, extend it to 24½" and carry on your QSO. Has pocket clip. 5¼" collapsed.

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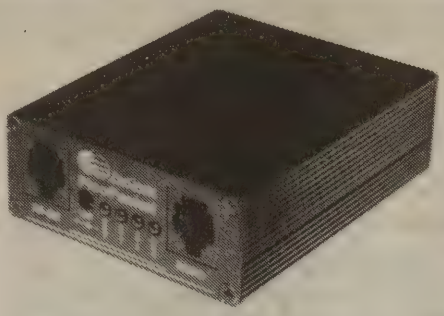

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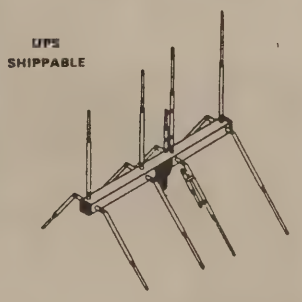

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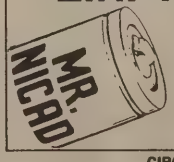

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What's Next?

by Carole Perry WB2MGP

Who Says Money Doesn't Grow on Trees?

If you are a teacher in these days of budget cuts, you are probably buying a great deal of your supplies with your own money. If you are teaching a ham radio program in particular, I know you must be begging, borrowing, or trying to be very creative with fund-raising techniques. I've written many columns both in *73 Amateur Radio Today* and in this magazine as well on the best approaches to use when applying for a grant.

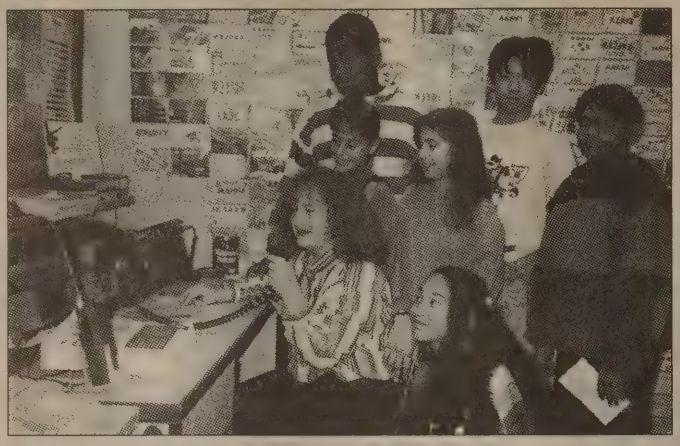


Photo A. If you teach a ham radio program, you will need to "grow your own money tree."

I recently came across a helpful article about how to "grow" a few good money sources of your own. In the August issue of *Learning* magazine, Rose Reissman gives some good pointers about pursuing a grant. If you've got a few good ideas of your own, why not pass them along and share them with other instructors through this column! The following list contains Rose's principal suggestions:

1. Getting started

Grants are typically given by two sources: corporate foundations and the federal government. These sources issue something called an RFP, that is, a request for proposals. The RFP describes the specifics of how you get the grant, who's eligible, what kinds of projects are funded, and exactly what you need to do to apply. Request the RFP from the funding organization and read it carefully. Follow the directions in the RFP as you write your grant proposal.

2. What will a grant pay for?

Every RFP has a budget section that describes what you can use the money for. Software, computer supplies, and telecommunication costs are usually funded. Very few grants fund computer hardware, though. Be sure your supervisor or school business manager is aware of any related fiscal responsibilities if you receive a grant.

3. What your grant needs to include

Every grant you apply for may be a bit different, but generally your proposal must include:

a. A summary of your project or program.

b. A needs assessment or problem statement that explains why your program is important and what problem it addresses.

c. A goals or objectives section that describes the general goals for your program and your specific, measurable objectives.

d. An activities or implementation schedule that explains what the program involves, whom it targets, how you'll let people know about it, and what your time line for getting started is.

e. A personnel section that describes who will do what.

f. An evaluation section that explains how you'll decide if the program met its objectives.

g. A budget that lists each item requested and its cost.

4. Some tips for working with a corporate foundation

Try the following strategies suggested by Stanley Litow, director of corporate support programs for IBM, and Ruthann Grey, vice-president of communication for Hoechst Celanese Corp., in *Education Grants Alert* (November 17, 1994):

a. Read the company's stated goals. Design your project or program to complement them.

b. Get the company's employees involved in your program, and have them help with its design.

c. Publicize the company's involvement in your program as much as possible.

d. Don't stop collaborating after you receive the funds.

Who's in the money?

Here are some good sources to find out what grants are available:

1. *Education Week*, "Deadlines" section.

2. *Teacher Magazine*, "Extra Credit" section.

3. *Education Grants Alert*, published by Capitol Publications, Inc., P.O. Box 1453, Alexandria, VA. 22313-2053. A one-year subscription costs $299, but it's published 50 times a year and contains information on federal and foundation grants from $500 to $1 million.

4. *The Federal Register*, available in public and college libraries.

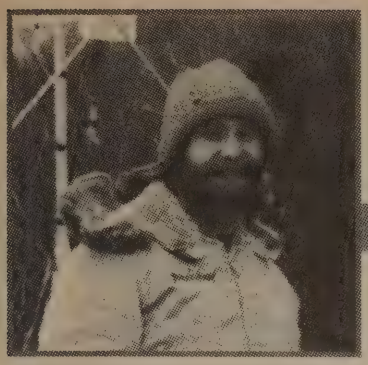
5. *The Catalog of Federal Domestic Assistance*, available from the Government Printing Office, (202) 512-0132.

6. The Foundation Center, 1-800-424-9836.

7. Funding Sources Database, which lists more than 2,000 sources for grants, 1-800-923-3317. Cost is $199.

8. State directories that list private foundations, their mission statements, funding guidelines, and contact numbers.

Why not give it a try? If you are successful, please share your secrets with the rest of us. RF



The Tech Side

by Michael Jay Geier KB1UM

Sound!

Although hams send pictures, computer data, Morse code—you name it—over the air, more than anything else we send voice. It makes sense, because voice is the normal human mode of communication, and most people find it easiest and fastest. Besides, we're just plain comfortable with it.

In order to get your voice across the ether to another ham, you need to have all kinds of things, including a radio, antenna, license, electricity, usable ionospheric propagation, and so on. Between your voice and your radio is the microphone, and its characteristics matter a great deal. This month, let's look at issues regarding audio, because, ultimately, sound is what it's all about!

Communication Vs Hi-Fi

The chances are that you own some kind of audio equipment, be it a portable headphone stereo, a full-blown audiophile monster system or, more likely, something in between. Especially with CDs so popular, everyone is getting accustomed to hearing nearly perfect, noise-free sound all the time. Not that long ago, FM stereo was considered "hi-fi," and good LP recordings (remember those?) seemed nothing short of amazing. By today's standards, though, FM stereo is good enough only for listening to in the car, and the vinyl record seems so noisy that many people can't stand it at all. As our ears get trained, we are bothered by things we used to ignore. It's much the same with visual stimuli. Take computers: Do you remember when the Apple II's graphics were considered high resolution and looked fabulous? We all loved the games and animation—wow, they were even in color!—but we would find them primitive and hard to take in today's world of super VGA and Macintosh graphics.

Undoubtedly, you've noticed that amateur radio doesn't sound anything like what you're used to hearing, even on FM stereo. The fact is that ham radio just isn't hi-fi. That's not some kind of sloppiness on our part, though—it's deliberate! As it happens, commercial two-way and public service radios don't sound any better. Why would we want to make our communications systems sound less than great? In one word: economy.

Squeeze 'Em In

No, I don't mean that we want to make our radios cheap! In fact, ham radio gear isn't cheap at all. Most of it costs a lot and is made very well. I'm referring to the spectrum cost of sending high-fidelity information. The wider the audio frequency response you send, the more bandwidth (space on the frequency spectrum) you use up. Recognizing this, the FCC has deemed that our voice signals shall have no more than 3 kHz (3,000 cycles per second) of frequency response. To give you an idea of how little that is, a telephone gives you 5 kHz, FM stereo goes to 15 kHz, and a CD player goes to 20 kHz, which is about the limit of human hearing with a good, young set of ears that hasn't yet been ruined by overexposure to loud rock music. For many middle-aged people, 12–15 kHz is the upper limit, while some elderly folks and rock musicians often can't hear over about 8 kHz on a good day.

Other Factors

There's more to audio fidelity than frequency response, however. Two other big factors are noise and distortion. On both of these issues, two-way radio gear falls short of the hi-fi mark, too. On HF (high frequency or, ironically, the "low bands"), signals usually refract off the ionosphere when long distances are involved. Nature being the imperfect lady she is, the steadiness of that refraction is poor, resulting in fading, blasting, and other maladies. So much for hi-fi audio.

On VHF/UHF, things are a little better. Up there, we usually use FM, which is capable of darned good audio. Communication distances tend to stick to line-of-sight range, so ionospheric disturbance is pretty much nonexistent. So, why don't our walkies and mobiles sound like commercial broadcast radio? For one thing, we use very narrowband FM deviation (modulation), which goes farther for a given amount of power and lets more stations share the band. The drawback is that, even with strong signals, it is noisier than wideband deviation, because the tiny wobbles and noises present in the transmitted signal represent a bigger percentage of the total modulation, making the receiver interpret them as louder sounds during detection (or "demodulation").

Intelligibility

We really don't mean for two-way radio to exhibit hi-fi sound. Rather, we're after another goal: intelligibility. That just means the most understandable reception of speech, even under bad conditions. It would seem intuitive that the most intelligible signal would be the one with the highest fidelity, but it doesn't work out that way. As it happens, you can do things to speech signals that make them sound worse but also make them easier to understand though noise and fading. These processes are a kind of deliberate distortion. Let's look at a few:

Getting Flattened

On HF, a very popular form of intelligibility enhancement is called "speech processing." This process takes the voice signal and amplifies it in a circuit until the peaks are clipped off. Then, the signal is filtered to remove most of the harmonics and other wideband noise that results from such clipping. The result is that the softer sounds in speech are brought up to a level almost equal to the louder ones. At

the receiving end, it sounds a little peculiar, but it makes it much easier to hear the speaker's softer syllables, which hold many clues to understanding words. A processed signal often can be clearly heard where an unprocessed one would be hard to decipher. By the way, hams tend to fall into one of two categories: They either love speech processors or they hate them! That's a result of many hams' pushing the processing too far by turning up the processor control toward maximum. The resulting sound is grating to the ear. Heck, on some radios you can turn it up so much that the distortion products aren't completely removed, resulting in an RF signal that's way too wide to be legal and annoys hams on adjacent frequencies as far away as 10 or 20 kHz. We call it "splatter."

Getting Squashed

Another form of intelligibility enhancement used on HF is compression. This is something like the automatic volume control on a cassette recorder, only faster. This one "rides the volume control" fast enough to keep it fairly constant between spoken syllables. Although it doesn't create the kind of distortion you get with speech processing, it still sounds weird if pushed too far. Its ultimate effect is similar to the clipping system, in that it equalizes the levels of loud and soft sounds. It's not quite as effective in punching through noise, though, so the clipping is still preferred by most hams, despite its often-realized potential for ugliness.

Up Yonder

These forms of processing are used on HF, not VHF or UHF. Why don't we use them there? For the most part, they just aren't necessary. Our use of FM for most VHF/UHF work, along with the much lower atmospheric noise in that part of the spectrum, lets us have clean enough sound to begin with that we just don't need to crud it up with deliberate distortions. Besides, with weak signals on FM, adding extra modulation can have the opposite effect it has on AM and SSB; it can make your signal drop into the mud. Most rigs in these frequency ranges do employ a small bit of compression just to keep the signal within prescribed modulation limits, but that's about it. So, why do they often sound so different?

The Ear

Your radio's ear is its microphone. Given the essentially low-fidelity nature of the ham radio medium, what possible difference could the mike make? More than you might think! True, the upper frequency response of just about any microphone is greater than our measly 3 kHz, so that doesn't matter. The low frequency response does matter somewhat, but because our radios cut off below about 200 Hz, you're still not talking about that much difference. What's left?

Between the Lines

Imagine a graph with a line on the left representing 200 Hz, and a line on the right representing 3 kHz. Between those two points, you can draw a heck of a lot of different curves and wiggles. Different microphones have frequency response curves that can vary quite a bit. Let's look at a few!

Condenser mikes, used on all FM walkie-talkies and some HF radios these days, have the flattest curves of all. That means they interpret your voice pretty honestly. Is that good? On VHF/UHF FM, they sound nice. Remember, with this mode we aren't so concerned with punching through noise; we just want clear sound. On HF, though, condenser mikes tend to sound "brassy," which means the lower frequency response is too strong. In fact, it is the correct response; it just isn't the one we find most desirable. Thanks to the structure of the human vocal system and ear, many clues that help intelligibility are located in the 2–3 kHz range. By reducing the lower frequencies, we can make the radio appear to increase the upper ones, as in turning your stereo's bass down makes it seem that there's too much treble.

Ceramic mikes are often used to achieve that "peaky," trebly sound DXers (people who work foreign stations) love so much. These mikes have a natural response curve that rises with frequency, giving them that punch. To simulate the ceramic-mike sound, some newer radios have a "high boost" switch that increases the treble sounds at about the same rate as a ceramic mike.

Dynamic mikes, which are magnet/coil combinations almost exactly like speakers, also have a rising response curve. Theirs is not so dramatic, however. Older FM rigs used them, but they were replaced by the now-common condenser mikes, which are smaller and cheaper. Also, dynamic mikes sometimes have very poor low frequency response, so much so that they have a "yelling down a hollow tube" quality many people find annoying.

Well, I hope you've enjoyed this little sojourn down the audio path. Until next time, 73 from KB1UM. RF

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ANOTHER TEXAS BALLOON

The North Texas balloon project will launch its seventh high altitude balloon experiment carrying amateur radio payloads on the 19th of August. The payload carries a variety of radios and instruments that can be easily used by any amateur with a Technician's license or above.

The launch will be from Clifton, Texas at approximately 9:30 AM Central Daylight Time. In the event of inclement whether, the launch will be delayed to the next day.

There will be a pre-launch net at 8:30 PM on the Ft. Worth 146.76 repeater the evening before the launch. The morning of launch there will be an HF net on 7.155 MHz. The Net control station will probably be W5IU. QSL's can be had through KG5OA via his callbook address. TNX *Newsline*

NEW INTERFERENCE HANDBOOK

The FCC has also released a new Interference Handbook for consumers. The 24 page, full color book will be stocked by FCC field offices around the country. This, to provide people experiencing interference to home electronic equipment with information and solutions to interference problems. Contact your local FCC office for information on the availability of this new publication. TNX *Newsline*

Antennas, etc.

by Joseph J. Carr K4IPV

Meanderings and Miscellania

Every now and then I like to clean up a few topics from my mailbag that seem to have a wider interest than just to that of the letter writer (by the way, I can be reached at P.O. Box 1099, Falls Church, VA 22041). This month, we will take a look at a couple of topics from the mailbag.

Height Does Help

One letter writer inquired about the impact of height on antenna performance. He was having an argument with another ham operator over the role of height. One of them (he didn't say which) claimed that height was critical on VHF and UHF, but didn't make much difference on HF except for close to the ground, while the other said that height helped on all bands. The "all bands" side of the argument wins! Height always helps.

Perhaps one factor in this argument was that antennas typically perform differently close to the ground. For example, one thing commonly noted is that dipole patterns are "best" (whatever that means) optimized at half wavelength above ground. Similarly, a vertical works best if its feedpoint is an electrical quarter wavelength above ground (which isn't always the same as the physical quarter wavelength). However, if either antenna were at three or four wavelengths above ground, then it would work even better.

I've seen beams and dipoles on top of 120-foot towers that worked much better than the same antenna at the supposedly optimum 33 feet above ground (half wavelength on 20-meters).

A personal experience also indicates the effect of altitude, if not height. During a Field Day competition in the early 1960s, I was with a radio club (Northern Virginia Radio Club) on top of Bull Run Mountain in Virginia. That 3,000-foot hill had a fire tower and several radio towers on it (now inaccessible because it's on private property and has an amateur astronomy club observatory at the peak). We ran 25-watt transmitters on CW in order to qualify for the ARRL points multiplier for low-power operation. On 80 and 40 meters, we used a trap dipole 133-feet long. It was rigged from the top of the tower to a tree down the slope. Even on 80 meters we found no difficulty working KH6 stations in Hawaii, as well as all the lower 48 states.

About 10:am Sunday morning, I was working 40 meters CW, furiously grabbing all the points I could, when one of the fellows popped into the tent and told me the antenna was down. Inspection revealed that the dipole's coaxial cable had broken, and was draped across Virginia's famous honeysuckle bushes down the side of the mountain. Still more inquiry revealed that the antenna had fallen around midnight the evening before, a fact confirmed by the operator on duty at the time, who had noted a sudden change in the VSWR and had readjusted the Johnson *MatchBox* ATU and kept on operating (points are important). We had worked scores and scores of stations in 30–40 states, including KH6IJ in Hawaii, during the time the antenna was down. I attribute the operating success to the altitude of the mountain more than any other factor.

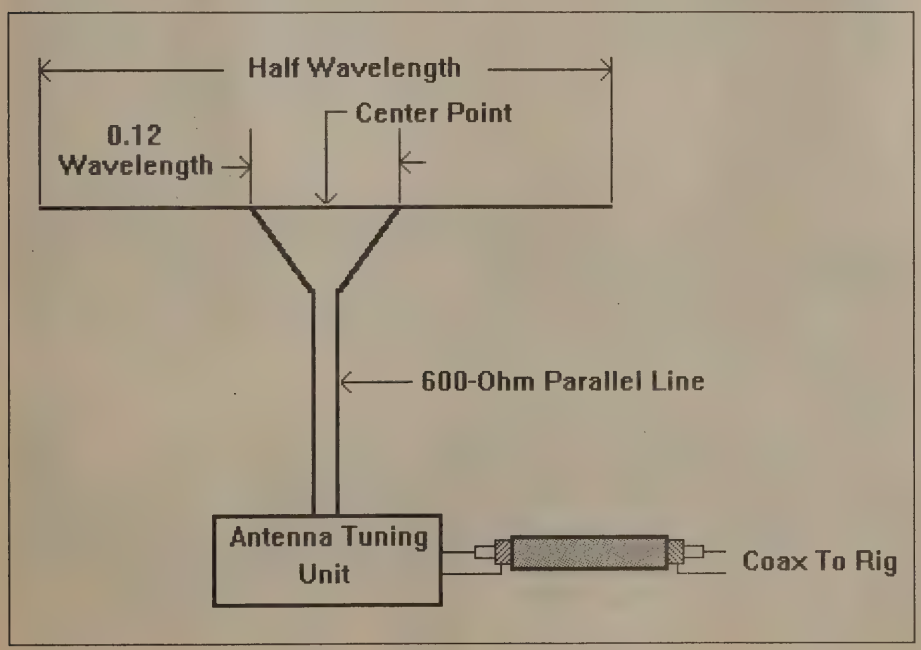

Figure 1. Delta feed antenna.

Delta Feed

Another reader asked about something called "Delta feed." Wow! It's been a while since I heard anyone interested in this feed method, but it's still useful and some people feel it's more efficient than coaxial cable-fed antennas because the 600-ohm parallel feeders it uses are more efficient than coax.

Figure 1 shows the Delta feed system used on a dipole. The antenna radiator is a half wavelength long (as for most dipoles), and its physical length in feet is found from the usu-

al $468/F_{MHz}$ (where frequency is in megahertz). The radiator element is not broken in the center, as for most half-wavelength dipoles, but rather is continuous. The feedline is 600-ohm "open-air" parallel feeders, but the ends are spread apart to points either side of the center point on the radiator. The total spread is 0.12 wavelength, or 0.06 λ either side of center. The total spread (0.12 λ) is found from $118/F_{MHz}$. Let's look at an example. On a frequency of 3.7 MHz (3700 kHz), the overall antenna length is 468/3.7 or 126.5 feet (126' 6"). The spread of the ends of the feedline is 118/3.7, or 31.9 feet (31' 11"). The feedpoints on the radiator are thus located 15.9 feet either side of the center point.

Multiband Dipole

Another reader asked why a multiband dipole (see Figure 2) works; that is, why don't the extra dipoles mess up the operation of each other. First, though, let's describe the antenna for those who might not be familiar with it.

In Figure 2 three dipoles are connected to the same feedline and 1:1 balun transformer. The balun is used at the feedpoint, even though the coaxial cable would provide a reasonable impedance without the balun. However, it's been noted and measured that using the 1:1 balun prevents distortion of the "figure-8" azimuthal pattern of the half-wavelength horizontal dipole caused by radiation from the feedline. L1a and L1b are each quarter wavelength on the lowest band of operation; L2a and L2b are each quarter wavelength on the next lowest band of operation; and L3a and L3b are each quarter wavelength on the highest band of operation. The overall length at each band (L1a + L1b, L2a + L2b, and L3a + L3b) is $468/F_{MHz}$, so each radiator element is half that ($234/F_{MHz}$). A practical example would be to make an antenna that works on 80 meters, 40 meters and 20 meters. The lengths would be:

Band	L1a & L1b (feet)
80	63
40	33
20	16

So why don't the three dipoles interact? Well, actually they do, but it's a negligible effect given the need for placing three antennas (or is that "antennae") on the same feedline. That might be needed for space or economic reasons. However, the pattern degradation isn't too terrible, and the impedance changes are basically ignorable. The reason why impedance problems don't pop up is that the off-resonance feedpoint impedance at frequencies very far removed from the design frequency is so high that it doesn't reduce the resistance all that much. It's somewhat similar to placing a 3,000-ohm resistor in parallel with a 73-ohm resistor. When this is done, the impedance drops from 73 to 71 ohms.

"So why don't the three dipoles interact?"

Antlers for Windows Software

If you own a Windows computer, then you might want to use the Antlers for Windows 2.0 software for calculating antenna lengths. It is available from me for $30 (P.O. Box 1099, Falls Church, VA, 22041). RF

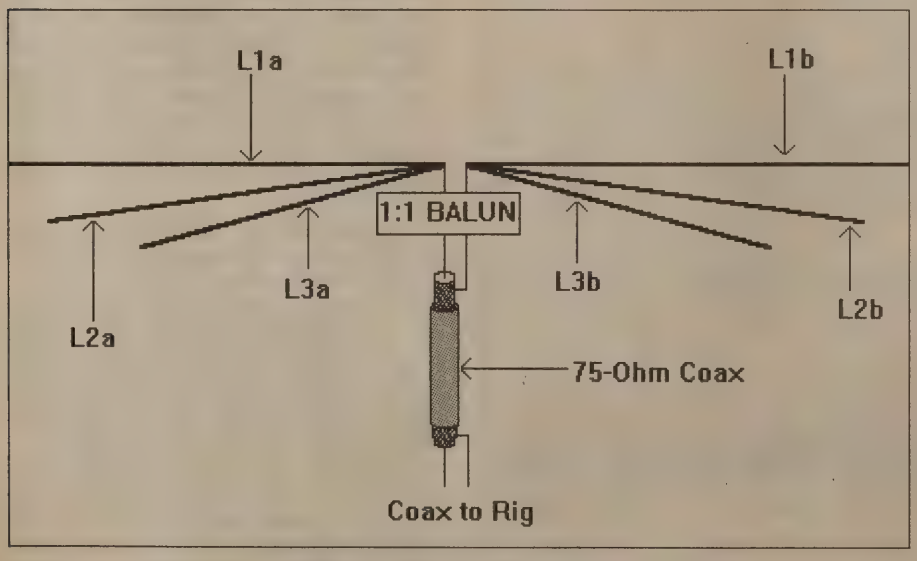

Figure 2. Multiband dipole.

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Upgrade . . . Don't Stop Now

by Gordon West WB6NOA

Cloning Controversy: Hamming Too Easy?

Leading ham radio manufacturers like Kenwood, Yaesu, and Alinco offer new mobile and handheld VHF/UHF transceivers that specifically have cloning capabilities. This allows you to transfer memory channels from one master unit over to another one without having actually to key in frequencies, offsets, tones, and alphanumerics. A wireless "over the air" clone takes about five minutes for up to 100 channels, and a hard-wire clone job to a computer can be done in as little as five seconds!

But cloning is not without criticism from some seasoned hams. "If newbies can't figure out how to program their HTs or mobiles, they have no business on the ham bands," commented a 4-lander at a recent hamfest. "You might call cloning a convenience, but we call it being too lazy to look up your favorite channels and stick them in the memory."

"Cloning sessions at our 78 Club meeting are always a highlight," comments Allen Robertson, KD6PYX, founder of the Southern California "78 Amateur Radio Club," originally started as a focus group for the Kenwood 78 transceiver. "The modern handheld or mobile VHF/UHF transceiver with 50-plus memories is an ideal scanner radio, too—and with so many frequencies to listen to, clone jobs are a special part of our meetings," adds Robertson.

You would think that amateur radio dealers who sell these modern mega-memory transceivers would take advantage of cloning capabilities. Most don't. Most won't. "If we take a new unit out of the box, we can no longer legally sell it as brand new," comments one amateur radio dealer. "We don't have the time nor profit margins to go to take a new unit out of the box, charge the battery, and go through the hassle of downloading memory from a master unit to the new set. The new ham just wants a unit that will start transmitting and receiving on hundreds of channels straight out of the box."

Photo A. Handhelds have no memory channels memorized when you turn them on for the first time.

Hey, that makes sense to me—why not?

Amateur radio manufacturers may be the lazy ones, too. Why not have the factories preload popular repeater channels and their offsets into 10 channels on VHF. Then load in the three national weather channels. Everybody's got a weather channel nearby, and almost everyone is served by "the top ten" repeater frequencies on 2 meters (as surveyed by Jay Mabey, NU0X, ARRL Repeater Directory editor):

146.940, 146.760, 146.880, 146.820, 147.000, 146.640, 146.700, 147.300, 147.060, 146.790; National Weather Receive: 162.550, 162.400, 162.475.

On UHF sets, pump in a few common repeaters plus some local public safety channels that are common throughout the country: 444.500, 444.100, 444.700, 444.800, 444.900; Public Safety: 460.025, 460.075, 460.100.

"It is beyond the scope of the Japanese manufacturers to offer us prememorized U.S. frequencies," claims one amateur radio manufacturer. "We think that all good hams should know how to program their equipment."

I agree. We should all know how to program our equipment, especially in the field when an emergency might strike and we need to immediately go to a new frequency that we don't have preprogrammed in our HT. But why not a little convenience for the new ham, who wants to begin hearing calls straight out of the box? When you buy a new dual-band transceiver, the memories are empty, and it comes up on 145 MHz and 445 MHz. Can you imagine buying a

Photo B. The Kenwood TH-78 got the ham world to accept cloning as a benefit, not a crutch.

new color TV and having it come up with flashing channel indicators asking you to select those channels active in your area, and to punch in the frequency of video and audio, and maybe stereo and surround sound? Newer TVs now click on for the first time, scan the outside antenna reception, then scan and load all of the available cable channels, and then give you alphanumerics that show you what is being beamed into your new setup.

The Southern California no-dues 78 Amateur Radio Club was first to unleash cloning capabilities in the Kenwood 78. Members would bring their radios into the club meeting, group themselves around a table with a master unit loaded with frequencies on VHF and UHF for the area, and subdivided for downloading into similar sets with basic memory, or expanded memory from the optional installed memory chip. While over-the-air cloning can be done from a repeater or city-wide simplex, the "around-the-table" cloning sessions help answer questions and allow the master cloner to work with all 78 Club members who want to explore their sets' advanced features. Other Kenwood transceivers beside the 78 which clone are the Kenwood 79, 22, 451, and 251; the 732 and 733 mobiles; and rumor is that the TS-50 high-frequency transceiver can accept a hard-wire clone job.

Over at Yaesu, the FT-11 and FT-41R single-band handhelds can clone, and so can the FT-51R dual-band, plus their new mobile FT-8500 which instantly accepts hundreds of channels of clone information. I say "instantly" because Yaesu hard-wires to a master unit or a computer for cloning in less than 20 seconds. It is a packet burst of channel information. With Kenwood sets, the on-the-air cloning takes a little over 5 minutes while DTMF tones relay the information.

Now Alinco joins the cloning program with their DJ-G5T which can hold up to 200 memory channels in both bands all set for an on-the-air cloning job. Can you clone an Alinco over the air from a master Kenwood set? I doubt it, but time will tell!

Yaesu is first to accept clone information from a software cloning program that works under Windows. The program customizes a popular frequency's database for all parts of the country. The RT Systems gang that brought you the Sam database (800-723-6922) deserves credit for this innovative program. Maybe they'll have some sort of contest where local amateurs can submit their top 40 VHF and UHF frequencies for communicating and monitoring, and this would give you capabilities to download a hot list just before you leave for your next trip across the country.

Amateur radio clubs across the country should consider cloning sessions. They are fun and educational, and I can't think of any ham who has a mobile or handheld transceiver that wouldn't want the latest frequencies for their particular area. You could become a "clone manager" with the new RT System's database for Yaesu radios. Maria KC6ABM at Kenwood says that all new Kenwood handheld and mobile units were specifically designed for cloning—so give

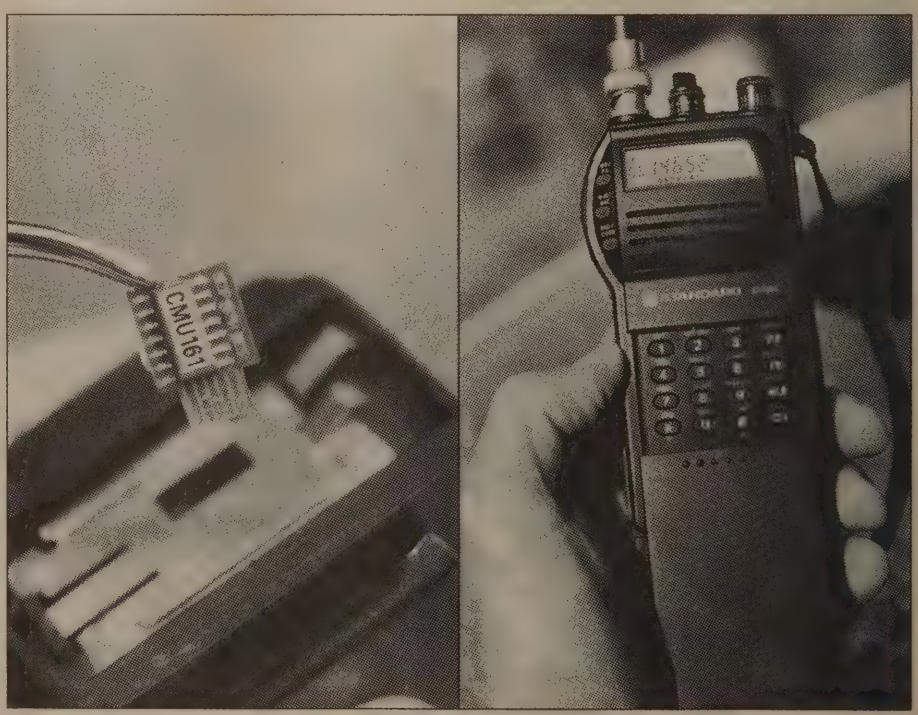

Photo C. Mega-memory chips will hold hundreds of cloned channels.

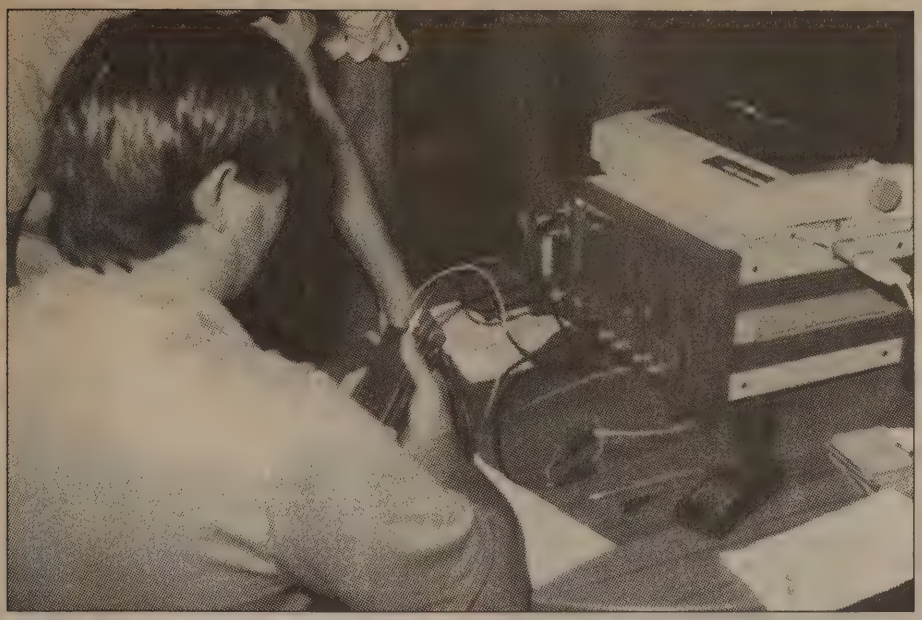

Photo D. The master cloning radio is first checked out on a service monitor for proper DTMF levels.

it a try! Alinco is now joining in with their new clonable handheld, and Icom soon will have cloning capabilities, too.

What? You have an older set that doesn't have clonability? Come to the cloning sessions anyway, and punch in those hot frequencies in the paperwork you receive by attending.

And next time you stumble across a simplex frequency and hear five minutes of endless touch-tone chatter, you'll know you are listening to the Kenwood or Alinco cloning sequence. And who knows what might be behind that packet burst you hear down at 145 MHz. It very well could be a Yaesu listening to the instructions from a computer that will transfer data in less than a few seconds.

Cloning is in. Dealers, this could boost your competitive edge over those who might sell VHF/UHF sets "brain dead" out of the box. Gee whiz, it might take all of five minutes to clone up the top ten. And manufacturers, if you are already loading marine channels in marine handhelds, does it really cost that much to plug in a few top-40 ham frequencies in handhelds and mobile equipment?

Cloning may be controversial, but it's come into its time. RF

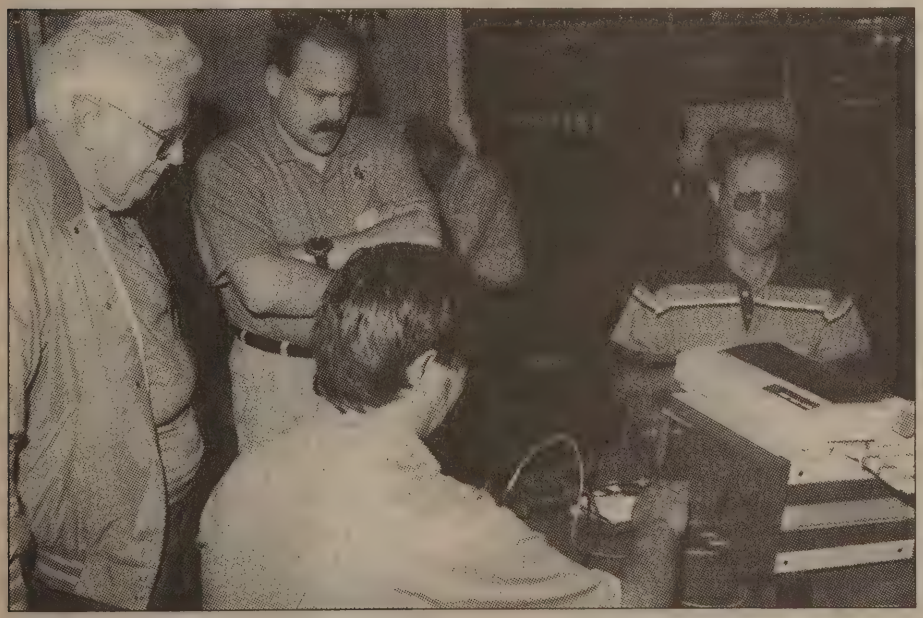

Photo E. Two hundred channels loaded in five minutes in 30 Kenwood radios all at once!

Walking-Stick Yagi?

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MPB-10	1.5 x 2 x 5	2.50	3.00
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MPB-12	1.5 x 6 x 5	4.25	5.05
MPB-13	2 x 2 x 2	2.20	2.60
MPB-14	2 x 4 x 2	2.65	3.15
MPB-15	2 x 6 x 2	4.40	5.00
MPB-16	2 x 8 x 2	6.05	7.35
MPB-17	3 x 2 x 3	2.45	2.95
MPB-18	3 x 4 x 3	2.90	3.50
MPB-19	3 x 6 x 3	4.20	4.90
MPB-20	3 x 8 x 3	4.65	5.45
MPB-21	4 x 6 x 3	4.55	5.15
MPB-22	4 x 10 x 3	4.75	5.45
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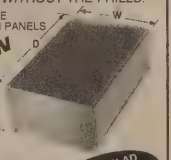

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CIRCLE 167 ON READER SERVICE CARD

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Available thru dealers, the ARRL, or send $29.95 + $4 S&H (CA residents add $2.32 tax) to: GGTE, P.O. Box 3405, Dept. MS, Newport Beach, CA 92659 Specify 5 ¼ or 3 ½ inch disk.

CIRCLE 193 ON READER SERVICE CARD

Radio Magic

by Michael Bryce WB8VGE

The Fun of Building It

Having hands-on experience with electronics goes a long way toward your understanding of ham radio. One of the best ways to get hands-on experience is to build electronic kits.

In fact, in the early 60s there were more kits than commercial equipment on the air. And of course the leader in electronic kits was Heathkit, with the Knight kit a very close second. Thanks to Heathkit, you heard, "The rig here is a hot water 101" all over the bands. Well, Heathkit is no longer making kits, and the Knight kit shut down long ago.

There were many different reasons for the decline of large kit building. Some of the kits were as expensive as ready-built gear, while other kits did not perform as well as commercial units. And, people just did not have (or want to spend) the time to build a complex kit such as an SSB transceiver.

For awhile, you simply could not locate electronic kits for ham radio. But, that's all changed during the first few years of the 90s. Now, there's a wealth of kits out on the market. Some are rather complex while others are geared toward the newcomer. Let's look at how kit building can be both fun and rewarding.

A Place to Work.

No matter if the kit is as simple as a code practice oscillator or as complex as a PLL transceiver, you'll need a place to set up shop. Now, don't even think of using the kitchen table unless you're single—then it's all right. You need a place to work that you can allow to remain cluttered, if need be. Kit building should be fun and not rushed. You don't need to spend half of your time cleaning up your work area so the family can eat.

Many of the newer circuits contain some extremely small parts. Since you'll need a source of glare-free light, you can purchase a hand-held light at most office supply/art supply stores.

Also, I've only recently started to use one, but a circuit board holder is very handy to have. Panavise sells one, and it's the unit I use. After years of stuffing PC boards the hard way, it does take some getting used to. Still, I recommend using a holder, even if it's a homemade jobbie out of wood.

"No matter if the kit is as simple as a code practice oscillator or as complex as a PLL transceiver, you'll need a place to set up shop.

The Right Tools

Because you don't use a sledge hammer to repair pocket watches, you should use the proper tools when assembling your kit. Radio Shack carries a fair amount of electronic hand tools. Look for their upper-end tools and don't be taken in by cheap prices. Cheap tools will only bite you in the butt down the road. Sears also handles a wide variety of small hand tools for electronic repair. Most of the larger electronic supply houses such as Mouser and Digi-Key also sell hand tools as well as soldering irons.

As a minimum, you should get the following:

- Set of slotted screwdrivers.
- Set of crosspoint screwdrivers.
- A complete set of TORX screwdrivers (some newer radios use these crazy screws).
- Two needlenose pliers, one with an extra long nose for those hard-to-get-at places.
- A real good soldering iron with interchangeable tips. The iron's wattage should be between 18 and 35 watts. If possible, get a soldering iron that has a grounded tip. This will help you avoid damage to static-sensitive parts such as CMOS chips.
- A second soldering iron with a wattage of at least 45 watts, perhaps larger. You'll need one of these guys for soldering PL259 connectors and other large metal parts.
- Oh yes, don't forget the auto range digital VOM. Pick one up at Radio Shack, or do your thing via mail order. Radio Shack always seems to have one or two models on sale. If you have the money, pick up a second VOM, but this time make it an analog version. The analog meter is ideal for peaking up a tuned stage. It's easier for the brain to see the needle swing up instead of trying to count numbers.
- While you're at Radio Shack, pick up some desoldering braid. Grab two rolls of solder, one "light duty" and the other roll heavy duty. The thicker stuff works best for antennas and coax connectors. The thinner .062 gauge solder is ideal for PC boards. The thicker stuff makes it much more likely to generate solder bridges between pads.

Let's Begin

Now that you have a place to work and the proper tools, the very first thing you need to do is read the assembly instructions. Check for any updates the kit may contain. After you have read

through the instructions, begin the assembly. Most kits start by stuffing the PC board and then moving on to the assembly of the board into its case. Some kits don't come with a case, as that is left up to the builder. Also, many kits don't come with the necessary wire for interconnections between the PC board and the real world. Unless directed otherwise, use 22- or 24-gauge stranded wire. Use various colors to avoid confusion.

Instructions

This is the one component that can make or break a kit. If the assembly instructions are unclear or have missing steps, the kit can be a disaster. No amount of troubleshooting can track down the faults if you assembled your kit by following screwed-up assembly steps.

The instructions should include a schematic, part overlay for the PC board, and tune up or calibration steps. The instructions may not include step-by-step guides for each and every part. Some of the smaller kits just instruct you to "install all the resistors" and then "install all the capacitors," with nothing more said. Other times, you'll see very detailed assembly instructions with every step shown.

"Building your own gear using kits is a lot of fun. It's even more enjoyable the first time you apply the juice and it works."

Building your own gear using kits is a lot of fun. It's even more enjoyable the first time you apply the juice and it works. But wait! What if you're not one of the lucky ones and your kit is dead on arrival? Well, next month we'll look at that problem as well as others you may encounter.

Don't have a lot of money to try your hand at kit building? I have built up some more of the DYI keyer we did a year or so ago. The keyer is easy to build and lots of fun to operate. It makes only dots and dashes, nothing else. It's not an "iambic" keyer. The best part is the price, as it's still $15 for the complete kit. If you're interested, contact me at the address shown. RF

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CIRCLE 68 ON READER SERVICE CARD

What you missed in *73 Amateur Radio Today*

If you don't read the September issue of *73 Amateur Radio Today*, here is some of what you're missing:

• Got fussy neighbors but want to go DXing? How about letting John Reed W6IOJ solve your problem with a "Simple J-Type 10m Vertical," a versatile but unobtrusive antenna.

• And while you're drivin', get cookin' with Dale Williams K3PUR's "Tuner Helper." With a dashboard LED and a tuner that sings to you, you won't need to take your eyes off the road to tune that antenna.

• Would you like to get directionality on 75m, with some 160m capability as well, using a familiar antenna without moving parts? If you think it's "Just Another Loop Antenna", Jon Sehring WB2EGQ will disabuse you of that notion. Read about the oddities of this form, he's discovered.

• If there's a tuner that sings like a bird, here's an antenna that looks like a cage! O. B. Boddie W1ZB/6's "Discone Antenna for 10 Meters" works like a yagi, but better.

• Think you have a good bridge? Find out for sure by building Paul Wing K1WVX's little unit in "Check Your SWR Bridge."

• If you feel like exploring new realms, go to the undervalued lower frequencies. Richard Marris G2BZQ will be your guide for "Longwave-Plus DX Techniques."

• Can you use this radio without reading the manual? Steve Katz WB2WIK/6 can. He says "The Icom IC-738 HF Transceiver" is a sturdy and popular rig you can run right out of the box.

• But you can leave home and still keep up on the SW action with the "Sony ICF-SW100S Pocket Shortwave Receiver." According to Mike Geier KB1UM, it runs 18 hours on just two double-As.

You should read the September issue, and *every* issue of ***73 Amateur Radio Today!*** Order now and save $27 off the cover price. You'll receive a one-year subscription (12 issues in all) to the best ham magazine money can buy, for just $19.97. For instant service call toll-free (800) 289-0388. Do it now!

Radio Fun *flea market*

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar, and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *Radio Fun Flea Market* costs you peanuts (almost)-comes to 25 cents a word for individual (noncommercial) ads, and 80 cents a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple of months before the action starts; then be prepared. If you get too many calls, you priced it too low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right, and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using.

Send your ads and payment to *Radio Fun Flea Market*, 70 Route 202N, Peterborough NH 03458 and *get set for the phone calls.*

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby, (Copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM,** N3RF, **SVANHOLM RESEARCH LABORATORIES,** P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. RF445

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Activities Calendar *compiled by Joyce Sawtelle*

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202 N, Peterborough, NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

SEP 9

UNIONTOWN, PA Uniontown ARC Inc. will hold its annual Gabfest on the club grounds on the Old Pittsburgh Rd. (just off Rt. 51 and the 119 by-pass). Vendor tables only if reserved in advance. Contact *Carl WA3HQK, (304) 594-3779.* Talk-in on 147.045(+) and 147.255(+).

SEP 10

MONETT, MS The Ozarks ARS will hold its annual Hamfest and Potluck dinner at the City Park (just south of intersection of Hwys. 37 and 60). Potluck dinner at 12:30 PM. Talk-in on either 146.97(-) or 145.23(-). For info, call *Harold KF0RH at (417) 235-7801(B), or (417) 235-8072(H).*

SEP 16

GONZALES, LA The "Gonzales Hamfest 95" will be sponsored by the Ascension ARC, 8 AM-3 PM at Gonzales Rec. Center. Setup at 7 AM. Talk-in on 147.225(+), CTCSS 107.2. Contact *George Turner KB5EOC, 16179 Galvez Ave., Prairieville LA 70769. Tel. (504) 622-3598.*

SEP 24

LONGMONT, CO The Boulder ARC will hold its annual "Swapfest" at the Boulder County Fairgrounds, 8 AM-2 PM. Talk-in on 146.70/.10 MHz. Contact *BARC, P.O. Box 2033, Boulder CO 80306;* or call *(303) 441-3883.*

SEP 30

HONOLULU, HI The Packet Group of Oahu will present its "Pacific Packet Conference '95" at St. Philomena Church, 3300 Ala Laulani St., 8 AM-3 PM. Contact *Dennis F. Morisada KH6NJ, (808) 737-8142 (eves); Packet: kh6nj@kh6tz.hi.usa.oc.*

HORSEHEADS, NY The 20th annual Elmira Internat'l Hamfest/Computerfest will be held 6 AM-3 PM at Chemung County Fairgrounds. Sourdough pancake breakfast at 6 AM. FCC Exams at 0900. Flea Market. Talk-in on Rookies Rptr. 147.96/.36, and 444.20. Make advance reg. checks payable to *Amateur Radio Assn. of the Southern Tier, Inc.*, and mail with an SASE to *Elmira Hamfest, c/o Dave Lewis, 465, CR 13, Van Etten NY 14889. Tel. (607) 589-7495.*

OCT 1

ASHLAND, OH The Ashland Area ARC will hold the North Central Ohio Hamfest at Ashland County Fairgrounds, 8 AM-3 PM. Talk-in on 147.105(+). Flea Market. Contact *Wally Green W3YXS, 3 Liberty St., Ashland OH 44805.*

SPECIAL EVENT STATIONS

SEP 9-10

SAXONBURG, PA The Butler Co. AR Public Service Group will operate KB3BIN, 1400Z-2100Z Sep. 9th, and 1400Z-2000Z Sep 10th, at the Saxonburg Festival of the Arts. Operation will be in the lower portion of the 40 meter and 20 meter General subbands. For a certificate, send a 9"x12" SASE to *BCARPSG, Inc., P.O. Box 141, Prospect PA 16052-0141.*

SEP 16

LAKE WINNIPESAUKEE, NH The Central NH ARC will operate KB1BRZ from the deck of the 235 ft. M/S Mt. Washington during a 50 mi. cruise around Lake Winnipesaukee. Operation will be 1200Z-1900Z on 29,333 21,333 14,333 and 7,233 +/- 3MH. Listen on 10m on the hour, 15m at 15 min. after the hour; 20m at 30 min. after the hour, and 40m at 45 min. after the hour. For a certificate, send 9" x 12" SASE and your QSL to *CNHARC, Box 1112, Laconia NH 03247-1112.*

SEP 19

DANVILLE, PA Liberty-Valley Elementary School will operate WC3A, N3IRN, and N3LQS, on the General portion of the 15, 20 and 40 meter bands, 1300Z-1900Z. For a certificate, send QSL to *N3POB/ D. Miguelez Liberty-Valley School, 175 Liberty-Valley Rd., Danville PA 17821.*

SEP 21-OCT 2

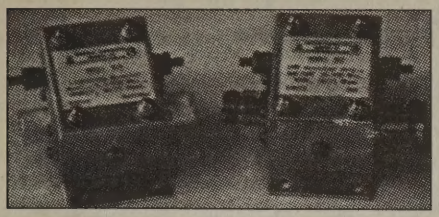
NIAGARA FALLS, ONT., CANADA Station CY3IARU will operate on 160m through 10m. Modes: CW, RTTY, SSB, Pactor, AMTOR, and possibly satellite. Send QSL info to *Dave Digweed VE3FOI, 2575 Rosedene Rd., St. Anns, Ont. Canada L0R 1Y0;* or QSL direct with an SASE. Others via the Bureau. Info via: *VE3FOI@VE3SNP#NIAG.ON.CAN.NA.*

OCT 7

MUSKOGEE, OK The Eastern OK Area Hams will operate KE5TC 1400Z-2130Z Oct. 7th, and 1700Z-2130Z Oct. 8th, aboard the WWII submarine "USS Batfish," to honor those serving on WWII submarines. Operation will be in the 80, 40, 20, 15 and 10 meter phone subbands. For QSL, send an SASE to *KE5TC, P.O. Box 436, Keota OK 74941.* RF

New Products

compiled by Victor Lapuszynski

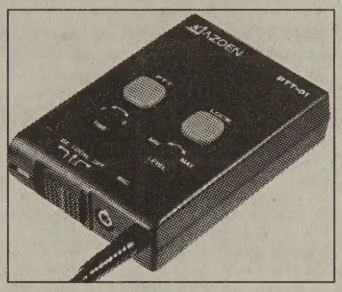


CABLE X-PERTS, INC.

Cable X-Perts, Inc., has announced that they have added the Industrial Communication Engineers products to their line. These American-made items include lightning protection, antenna-matching units, bandpass transceiving filters, impedance transformers, and many more related products to protect and enhance any amateur radio station, at reasonable prices without sacrificing quality or performance.

For a complete catalog, contact *Cable X-Perts, Inc., 113 McHenry Rd., Suite 240, Buffalo Grove, IL 60089-1797; (708) 506-1886 (tech. info), (708) 506-1970 (fax).* Or circle Reader Service No. 201.

AZDEN



Azden Corporation is offering a unique, new push-to-talk (PTT) switch, model PTT-01. This device can give any radio the advantages of remote PTT, variable microphone gain, adjustable frequency response, and automatic timed shut-off. You can use it with all kinds of microphones, including dynamic and electret. The LOCK button permits hands-off operation and an OFF-LOCAL-DX switch permits flat or peaked response at 2 MHz, both with adjustable gain to match microphone to radio. With a removable belt clip, Velcro tape, and soft desk pad, you can mount it anywhere. The unit measures 2.4" x .87" x 3.35". Suggested price is $40.

For more information, contact *Sid Wollin, Communications Division, Azden Corp., 147 New Hyde Park Rd., Franklin Square, NY 11010; (516) 328-7501, (516) 328-7506 (fax).* Or circle Reader Service No. 202.

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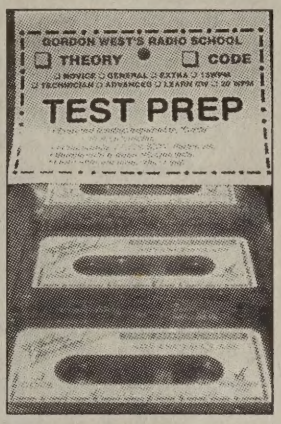

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